Chapter 11

Shoulder

CHAPTER CONTENTS

The shoulder has the greatest range of motion of any joint in the body. The shoulder's movement abilities are possible only at the expense of bony stability, requiring the soft tissues to play a more critical role in maintaining joint integrity. This increased responsibility for stabilization places the shoulder at risk for numerous soft-tissue injuries. There are four articulations in the shoulder girdle: the scapulothoracic, sternoclavicular, acromioclavicular, and glenohumeral joints. Disorders involving the glenohumeral articulation are most common. Its range of motion is significant, but it could not function properly without the combined motions at the other three skeletal articulations of the shoulder girdle. The anatomical structure of this area combined with its unique biomechanical demands place a heavy demand on the soft tissues.

Shoulder pain is the third most common musculoskeletal disorder, following low back and cervical spine pain.[1] Acute injuries result from incidents such as blows to the shoulder, falling on an outstretched arm, or forceful movements that dislocate or sublux the joint. Chronic injuries develop from the movement requirements in repetitive upper-extremity activities. Also problematic are activities requiring that the shoulder be held in a position that impinges soft tissues. Shoulder problems and injuries are common in sports, recreation, and assorted occupations.

INJURY CONDITIONS

FROZEN SHOULDER (ADHESIVE CAPSULITIS)

Description

The term frozen shoulder is used to refer to a set of symptoms in the shoulder involving pain and limited motion at the glenohumeral joint and is often used interchangeably with the diagnostic term, adhesive capsulitis. However, adhesive capsulitis refers to a discrete clinical pathology, whereas frozen shoulder refers to a variety of pathologies.[1] The pathologies that may be involved in frozen shoulder include not only adhesive capsulitis, but subacromial bursitis, calcific tendinitis, rotator cuff pathology, and other conditions limiting shoulder motion.[2] More than anything, frozen shoulder describes a functional limitation in range of motion associated with pain and stiffness. In frozen shoulder this limited motion appears directly related to dysfunction of inert tissues such as the glenohumeral joint capsule or coracohumeral ligament.

Adhesive capsulitis involves loss of active and passive motion due to adhesions within the gleno humeral joint capsule.[3] There is a distinction between a stiff and painful shoulder without any capsular involvement (frozen shoulder) and that involving adhesion within the joint capsule (adhesive capsulitis).[4] While the anatomical tissues involved differ between frozen shoulder and adhesive capsulitis, the symptoms, etiology, and clinical characteristics of the pathologies are virtually the same. In this discussion the term frozen shoulder is used unless there is a specific reference to adhesion within the glenohumeral joint capsule, in which the term adhesive capsulitis will be used.

Frozen shoulder is divided into two categories – primary and secondary. In primary frozen shoulder, the problem comes on with no apparent cause. There is some indication that it may be an autoimmune disorder but why the motion limitations develop is still unclear.[1] In a number of cases there seems to be an association between the onset of the condition and serious emotional or psychological trauma, but this connection is controversial.[5] There is a lack of agreement on how to treat the primary frozen shoulder due to the inability to locate its cause.

Secondary frozen shoulder results from another pathology, such as rotator cuff tears, arthritis, bicipital tendinosis or tenosynovitis, surgery, shoulder separation, diabetes, or glenohumeral subluxation.[2,6] The inciting trauma causes problems in the same tissues as primary frozen shoulder, although there is more evidence of capsular adhesion in the secondary variation. In secondary frozen shoulder, scar tissue from the prior trauma causes the axillary folds of the joint capsule to adhere to each other. Some period of shoulder immobilization generally precedes the onset of symptoms.

There are three stages that characterize the progression of frozen shoulder pathology:[6]

- Freezing: the onset may be anywhere from 10 to 36 weeks. There is likely to be pain and a gradual decrease in range of motion.
- Frozen: occurs between 4 and 12 months after the initial onset. Pain is likely to gradually decrease during this time, although motion is likely to remain quite limited.
- Thawing: this is the period characterized by a gradual return of range of motion and decrease in pain. It may be as short as several months, but it is not uncommon for it to last years.

A frequently overlooked cause of secondary adhesive capsulitis is the presence of myofascial trigger points. It appears that trigger point activity in the subscapularis muscle is especially likely to set off the cascade of adhesion in the capsule.[7] The subscapularis muscle appears prone to developing enthesopathy (inflammatory irritation at the attachment site) on the humerus near the joint capsule. The local inflammatory process at the attachment site will often cause fibrous adhesion to develop in the capsule, because the capsule is so close to the tendinous attachment.

One of the primary challenges with adhesive capsulitis is the self-perpetuating nature of the problem. The joint capsule is richly innervated so pain is out of proportion to the amount of tissue damage. As a result, the more it hurts to move the shoulder, the more the person avoids any kind of glenohumeral motion. This pain avoidance causes further problems with increasing limitations to motion. It is well documented that immobility and lack of movement is a primary cause of continued fibrosis.[3] Therefore, even though it hurts, some degree of movement is essential for the individual to improve.

Treatment

Traditional approaches

Traditional treatment for frozen shoulder begins with a conservative approach focusing on increasing range of motion. Gentle protective exercise, such as Codman's pendulum exercises, and regular stretching to improve range of motion are the main components of this approach.[8] Encouraging an increase in range of motion is important but results should not be expected too quickly. If an individual pushes the shoulder too far or too fast, it may tear some of the fibrous adhesion in the capsule and cause further pain avoidance, increase additional fibrous adhesion, and restrict range of motion even further.

Strengthening programs are often used to address frozen shoulder. The theory is that if the surrounding muscles have greater endurance and stamina they can reduce the demand placed on shoulder tissue during various movements. If there is a reduced demand on the shoulder, earlier healing may result. However, overly aggressive strength training methods are likely to make the problem worse by overtaxing the capsule and related structures.[9] Anti-inflammatory oral medications or with intra-articular corticosteroid injections might be used to reduce further inflammation and adhesion in the capsule. However, there is some question as to the long-term effectiveness of these strategies.[10]

When conservative treatment is not successful a more aggressive approach can be tried. Freeing capsular adhesions surgically is one option, but more commonly forced manipulation of the shoulder under anesthesia is tried first. In this procedure the client's shoulder is anesthetized with an injection. The arm is then forcibly moved into a position that stretches the glenohumeral capsule and breaks the capsular adhesions. The procedure can be effective for immediately increasing the available range of motion. However, it is best reserved for those with a high pain tolerance and strong motivation to exercise and stretch after the treatment. When the anesthesia wears off, the shoulder can be very painful. If not regularly moved, the fibrous adhesion is likely to return.

Soft-tissue manipulation

General guidelines Stretching is a very important part of the treatment process in frozen shoulder. Stretching procedures are aimed at increasing length and pliability in the joint capsule to address the fibrous adhesion in the connective tissues of the joint capsule. Connective tissues, such as the ligamentous tissue that makes up the joint capsule, stretch more effectively when there is a slower rate of stretch tension applied.[11–13] When stretched more rapidly the capsular tissue is more resistant to elongation. Consequently, when stretching capsular tissues in a client with frozen shoulder the practitioner should hold the stretch position for a longer period (20 seconds or more) as opposed to a short duration stretch.

In frozen shoulder fascial connective tissue around the shoulder joint can contribute to the range-of-motion loss and make it more difficult to mobilize and stretch the joint capsule. Myofascial approaches and massage techniques that reduce tension in the surrounding shoulder muscles are particularly helpful. Effleurage, sweeping cross fiber, and even active engagement techniques can be used.

Perform stretching of the deeper capsular structures after improving pliability in the superficial connective tissues with the massage techniques mentioned above. Heating these tissues prior to stretching is helpful as it increases tissue extensibility. Topical heating modalities, such as moist heat Hydrocollator packs are valuable to warm the superficial shoulder tissues. However, these topical applications are not able to increase temperature in the joint capsule due to the joint's depth. A deep heating method, such as ultrasound, is sometimes used to increase heat for improved extensibility in the capsular tissues.

One of the most important factors in the treatment of adhesive capsulitis is the positive support given to the client during treatment. This condition can persist for months and seriously affect an individual's ability to perform many upper-extremity movements. It is easy for the client to become depressed as a result of the prolonged pain and limited motion. Encouraging the client about even the smallest increments of progress in regaining range of motion is beneficial. A goniometer is a helpful way of quantifying small range-of-motion improvements and that information can be shared with the client. Quantifiable evidence of improvement helps the client keep a positive attitude and stay motivated for treatment.

Figure 11.1 Myofascial stretching to anterior shoulder girdle muscles.

Suggested techniques and methods Some of the techniques described for treatment of frozen shoulder involve movement of the affected glenohumeral joint. Any glenohumeral joint movement should be performed carefully and well within the client's pain tolerance. The pain from capsular adhesion in frozen shoulder is significant and reactive muscle splinting or capsular irritation can further impair efforts to gain extensibility in the capsule.

A. Myofascial release of shoulder region Limited motion in the shoulder region from capsular restriction can cause prolonged shortening of fascial tissues. This shortening contributes to further mobility restrictions. Fascial techniques are applied in multiple planes to provide the greatest mobility enhancement. The primary goal is to place a moderately light tangential (tensile) force on the subcutaneous fascia. Pulling the fascia in multiple directions enhances its pliability the most. Place the hands lightly on the client's shoulder region where the myofascial stretch is to be applied. Pull the hands apart to take the slack out of the tissue and apply a light degree of tensile (pulling) force between the hands (Fig. 11.1). Once there is a slight degree of pull between the hands, hold this position until a subtle sensation of tissue release is felt. Apply these myofascial techniques in the anterior as well as posterior shoulder girdle regions.

B. Sweeping cross fiber to anterior chest muscles Treatments aimed at the anterior chest muscles reduce limited motion in the shoulder so joint capsule stretching has the best opportunity to succeed. This technique reduces tension in superficial fibers of the pectoralis major and anterior deltoid. Stand facing the client's feet with the fingers anchored in the client's axilla. Use the thumb to perform sweeping cross fiber movements on the pectoralis major (Fig. 11.2). During the sweeping motion, the pectoralis major is sifted between the fingers. Similar sweeping cross fiber techniques can be applied to the anterior deltoid while facing in the same position (toward the client's feet).

C. Static compression for anterior chest muscles Apply static compression to areas of tension in the pectoralis major found during effleurage and sweeping cross fiber techniques. Trigger points or areas of muscle hypertonicity are treated with both broad and small contact surface static compression

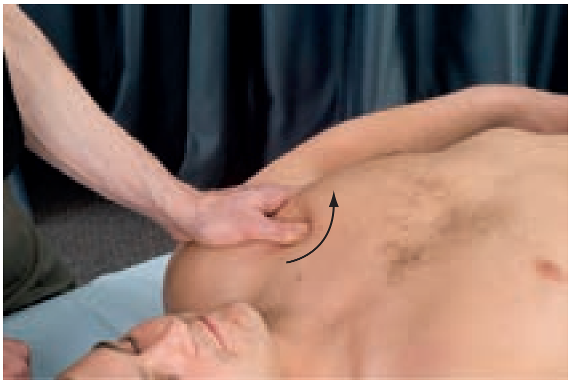

Figure 11.2 Sweeping cross fiber to anterior shoulder muscles.

Figure 11.3 Static compression to anterior shoulder muscles.

Figure 11.5 Static compression to subscapularis.

methods (Fig. 11.3). Hold pressure on trigger points or areas of muscle tightness for about 5–8 seconds, or until you feel the tissue release.

D. Deep stripping on pectoralis major Use the thumbs, finger tips, or pressure tool to perform deep stripping techniques to the pectoralis major. Treatment can move from medial to lateral or lateral to medial (Fig. 11.4). Variations on this technique, such as pin and stretch, can also be used especially in the later stages of frozen shoulder when mobility has been improved.

E. Static compression on subscapularis The subscapularis is a very important muscle in frozen shoulder treatment because its attachment site is close to the joint capsule and irritation of the attachment site (enthesitis) can contribute to capsular adhesion. Address hypertonicity and myofascial trigger points in subscapularis with static compression methods. The client is in a supine position. Hold the client's arm slightly away from their body. Use the finger tips of the other hand to apply static compression to the subscapularis muscle (Fig. 11.5). A variation on this technique is to have the client then perform small active medial and lateral rotation movements while pressure is maintained on the muscle.

Figure 11.4 Deep stripping to pectoralis major.

F. Capsular stretching Stretching of all the shoulder tissues is valuable, but stretching of the joint capsule is particular important. In the capsular pattern of the shoulder, the greatest motion limitation is in lateral rotation first, abduction second, and medial rotation third. Capsular stretching should focus on all of these motions, starting with lateral rotation, then moving to abduction, finally medial rotation. When performing capsular stretching slowly bring the client's shoulder into a position that is just short of the stretch position that causes pain (Fig. 11.6). Hold that stretch position for 20–30 seconds and then gradually come back out of the stretch. This process should be repeated several times. Holding the stretch position longer is valuable because the viscoelastic properties of capsular connective tissue are such that a slower and longer duration stretch does a better job of enhancing pliability in the capsule.

Rehabilitation protocol considerations

- It is crucial to identify the stage of the client's frozen shoulder condition (freezing, frozen, thawing, etc.). If treatment is attempted during

Figure 11.6 Capsular stretching.

the freezing stage, it may not seem to be immediately effective, but it may reduce further joint restriction and capsular adhesion.

- In the later stages of the condition (the thawing stage) more active treatment techniques, such as active engagement and pin and stretch, can be used. Mobility gains may appear more rapid at this time as well.
- Strongly encourage the client with any measurable progress in regaining shoulder motion and note that motion improvement is likely to be slow.
- Consider use of heat modalities prior to or in conjunction with massage treatment methods.
- The client's ability to relax and improve through soft-tissue treatment is directly related to the trust they place in the practitioner. A sense of confidence, compassion, and understanding for the nature of this sometimes intense chronic pain condition will help the client.

Cautions and contraindications Range-of-motion techniques and stretching, while helpful, can also perpetuate the condition or make it worse. Be conservative in the way stretching and range-of-motion techniques are applied. Even though progress may not be as fast, there is less chance of tearing the capsular tissues and causing the condition to worsen. Particular attention should be paid to the client's pain levels with various motions.

Box 11.1 Clinical Tip

A number of conditions can lead to limited motion in the shoulder. Do not be eager to assume the client has frozen shoulder simply because there is a range-of-motion limitation. Accurate evaluation of the condition is imperative in order to design an appropriate treatment approach. For example, shoulder impingement and adhesive capsulitis can create identical motion limitations in shoulder abduction. Yet, they are distinctly different conditions and the treatment approaches for them differ considerably. The primary measure of clinical success is appropriately matching the treatment strategy to the nature of the condition.

ROTATOR CUFF STRAIN

Description

The term rotator cuff tear is common, but it can be an incomplete description of the client's pathology. There are four rotator cuff muscles; any of these four muscles can be involved in the injury. It is rare for all four to sustain a tear at the same time. More than likely it is one or two of these muscles that are involved in a particular shoulder injury. Accurate assessment is essential to determine which of the muscles is involved.

The rotator cuff is composed of the supraspinatus, infraspinatus, teres minor, and subscapularis muscles and their associated tendons. The four tendons form a cuff around the head of the humerus and act to stabilize the head of the humerus in the glenoid fossa. The supraspinatus is the most commonly strained of the four rotator cuff muscles. There are several reasons why injury to the supraspinatus is more common. Due to the limited space, the supraspinatus can be compressed against the underside of the acromion process (Fig. 11.7).[14,15] The repeated compression against the underside of the acromion process contributes to tissue degeneration in the supraspinatus muscle/tendon unit, and eventually leads to fiber tearing.

Another factor that leads to supraspinatus dysfunction is that there is an area of decreased

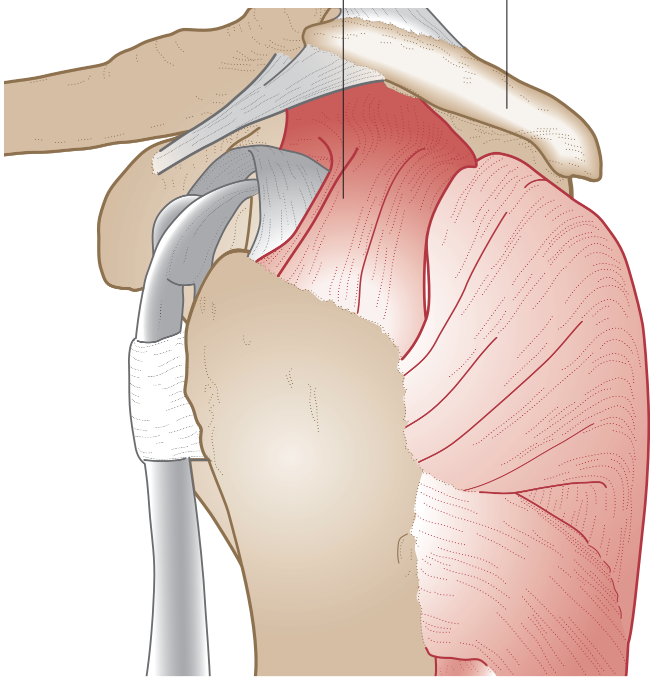

Figure 11.7 Lateral view of the left shoulder showing the small space under the acromion process.

vascularity near the insertion site of the supraspinatus tendon.[16] The decrease in vascularity means there is slower healing time for any tissue trauma in the area. In addition to strains, decreased vascularity of this tendon region also contributes to tendinosis, which may precede muscle tearing. Progressive degradation of fibers of the supraspinatus muscle and tendon may lead to calcific tendinitis in the area as well.[17,18] Calcific tendinitis is a deposition of calcium into the tendon tissue most commonly experienced at the supraspinatus tendon.

Rotator cuff tears typically occur as a result of progressive muscle and tendon degeneration over time. Many of these tears are only partial thickness tears where the tendon is not torn all the way through. A more serious injury is a full-thickness tear of the tendon, which is more likely to happen when the load on the tendon is much greater. Acute injuries that involve high force loads to the rotator cuff muscles produce more serious damage like a full-thickness tear.

The infraspinatus and teres minor muscles can also contribute to rotator cuff tendinosis or strain. However, the mechanism of injury to these muscles is somewhat different. These muscles both play a fundamental role in concentric lateral rotation movements and eccentric medial rotation movements in the shoulder. Injuries to the posterior rotator cuff muscles are common in throwing motions. During the follow-through phase of a throwing motion, the posterior rotator cuff muscles (infraspinatus and teres minor) are the muscles primarily responsible for slowing or decelerating the motion of the arm. Very strong forces are required to slow the arm's momentum in a throwing motion. If these muscles are not equipped for the force demands placed on them, tendinosis and then eventually fiber tearing can result. Fatigue of these muscles accelerates this degenerative process, so strength training and conditioning is a great preventive strategy.

The subscapularis is rarely strained. It is protected from strains because there are several larger muscles that perform the same actions and give mechanical support to the subscapularis. These muscles, such as the pectoralis major, latissimus dorsi, and teres major, are significantly stronger than the subscapularis and assist it significantly. However, subscapularis tears do occur, and often they accompany a more serious injury, such as a glenohumeral dislocation. There appears to be a greater incidence of subscapularis tearing with dislocations in patients who are over 40.[19,20]

Other shoulder pathologies frequently accompany rotator cuff dysfunction. The pain from rotator cuff disorders can create reflex muscular inhibition, which interferes with biomechanical balance around the joint, and can lead to limitations in range of motion. Sometimes it can be difficult to determine if the pain and limitation in range of motion is specifically from a tear or from the reflexive muscular inhibition that results.

Treatment

Traditional approaches

Physical therapy is a common approach for rotator cuff strains, and includes stretching, preventive strength training, and use of modalities such as ultrasound to facilitate healing of the damaged tissues. As with similar conditions, strength training can be a valuable part of the rehabilitation process, but it should not be undertaken too soon as repeated use of damaged muscles may exacerbate the problem.

If conservative treatment is not successful, injection therapy or surgery may be the next course of treatment. Injection of corticosteroids into the subacromial region may be performed to reduce inflammatory activity. There have been numerous reports of tendon weakness and rupture as a result of corticosteroid injection directly into tendons.[21–24] Complications of corticosteroid injection may be prevented if the injection is not given directly into the tendon. Complications are also reduced if the therapy is given at least 3 months apart with no more than two injections and resisted exercise is avoided for at least 1 week after the injection.[25]

Surgical procedures are used if conservative treatment or injection therapy has not had beneficial results. Most rotator cuff surgeries are for treating supraspinatus tears. A common surgery is a subacromial decompression, in which the surgeon increases space between the acromion process and humeral head by shaving off the underside of the acromion. Creating greater subacromial space decreases the likelihood of further supraspinatus fiber degeneration from compression in the area. This surgery is performed as either an open procedure with a larger incision, or as an arthroscopic surgery, which usually has a faster recovery period and less damage to surrounding soft tissues. If there is a full-thickness tear in the muscle–tendon unit, surgical repair is a bit more complicated. A procedure to stitch the tear site is necessary. Appropriate rehabilitation following the surgery is essential in order to gain the best results from any of these procedures.

Soft-tissue manipulation

General guidelines Once proper assessment has determined which of the rotator cuff muscles are at fault, soft-tissue treatment can focus on those particular tissues. As with any muscle strain, treatments are most effective when combined with a cessation or rest from offending activities. Because of the extensive upper-extremity movement in daily activities, it can be challenging for the client to halt or decrease certain offending activities. When treating a rotator cuff tear or tendinosis, it is valuable to treat all the muscles of the shoulder region to help achieve proper biomechanical balance.

If the supraspinatus is the primary problem, treatment with massage is more difficult. Tears are often located near the musculotendinous junction, which is largely inaccessible to palpation because it is underneath the acromion process. There are, however, other ways to treat strains in the supraspinatus. In a supraspinatus tear, there is likely compensating tightness or dysfunction in other soft tissues of the shoulder that should be addressed.

Massage is effective in treating tears or tendinosis in the posterior rotator cuff muscles because these muscles are superficial and easily accessible. Treat the entire shoulder complex to address compensating biomechanical imbalances. Stretching the rotator cuff group and surrounding muscles is also an essential part of the rehabilitative process.

Subscapularis tears are rare, but when present are difficult to treat because the large majority of the subscapularis muscle is inaccessible with palpation. However, the distal musculotendinous junction, where tears typically occur, is accessible to massage treatment. The subscapularis is treated effectively with friction and static compression techniques to the muscle belly.

Suggested techniques and methods

Treatments aimed at supraspinatus and subacromial region

A. Deep stripping to proximal fibers of the supraspinatus Reducing muscle tension on the tear site is crucial for proper tissue healing. Stripping techniques on the supraspinatus reduce pull on the region of torn fibers. The client is in a prone position. Place the thumb or fingertip anterior to the trapezius and on the proximal fibers of the supraspinatus near the vertebral border of the supraspinous fossa. Perform a slow deep stripping technique on the supraspinatus muscle to encourage tissue lengthening and reduction of muscle tightness (Fig. 11.8). This technique can be performed with the client in other positions if those are more comfortable.

B. Deep stripping to the deltoid muscle Hypertonicity in the deltoid can pull the humeral head in a more superior direction and decrease subacromial space. Perform deep stripping techniques on the anterior, middle, and posterior deltoid to help decrease muscle tightness that might contribute to lifting the humerus superiorly in the glenoid fossa and further compressing the supraspinatus tendon (Fig. 11.9).

C. Deep friction to the supraspinatus tendon insertion In some cases, the supraspinatus tear site is closer to the musculotendinous junction. In those cases, the site of injury can be treated with deep friction just lateral and inferior to the acromion process near the supraspinatus insertion on the humerus. Deep friction can stimulate fibroblast activity in the damaged tendon fibers and thereby contribute to a faster recovery rate. Locate the lateral edge of the acromion process of the scapula. With the thumb or finger tip, apply deep friction treatments to the distal supraspinatus tendon (Fig. 11.10). Stretching and joint range-of-motion techniques should be used after the friction treatment.

Figure 11.8 Deep stripping on supraspinatus.

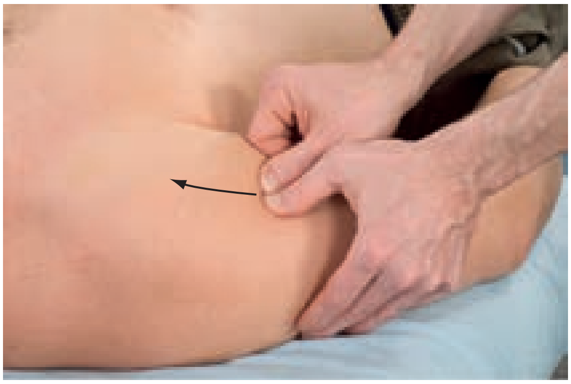

Figure 11.9 Deep stripping on deltoid.

Treatments aimed at posterior rotator cuff muscles

D. Static compression on infraspinatus and teres minor This technique is used to reduce tension on damaged muscle or tendon fibers. Apply static compression with a finger tip, thumb, or pressure tool to areas of increased tension in the muscles (Fig. 11.11). When applying pressure to the infraspinatus, keep in mind there is a flat bone

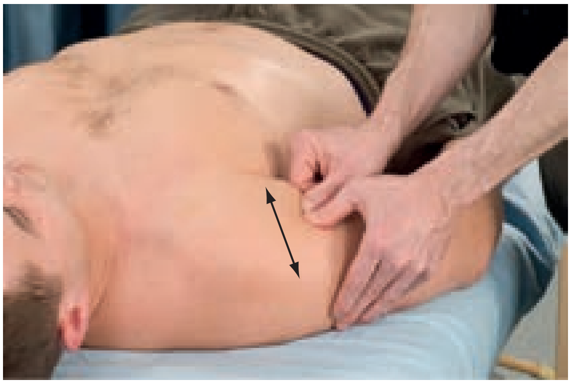

Figure 11.10 Deep friction to distal supraspinatus tendon.

Figure 11.11 Static compression on infraspinatus and teres minor.

Figure 11.13 Deep friction to posterior rotator cuff tendons.

underneath the muscle so pressure does not have to be strong to generate discomfort from muscle tension. When treating the teres minor, the muscle is not being pressed against a flat underlying bone, so the client can usually tolerate a slightly greater pressure level.

E. Deep stripping on infraspinatus and teres minor With the thumb or fingertips, apply a deep longitudinal stripping technique from the proximal to distal fibers of the infraspinatus and teres minor (Fig. 11.12). Continue the stripping technique several times until all the fibers of the infraspinatus and teres minor have been treated. This technique can also be performed in a distal to proximal direction if the practitioner finds that hand position more comfortable.

F. Deep friction to posterior rotator cuff region Apply deep friction to the region of primary tenderness in the posterior rotator cuff tendons

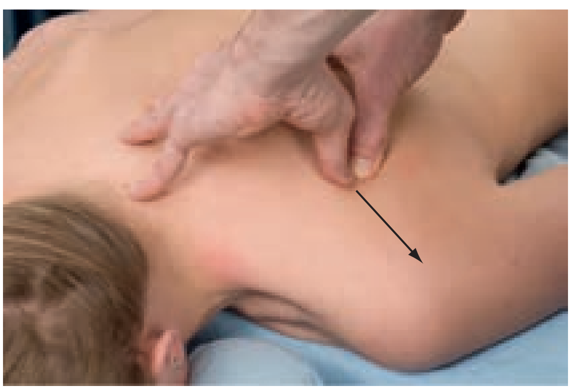

Figure 11.12 Deep stripping on infraspinatus and teres minor.

(Fig. 11.13). This region of tenderness is likely the site of tissue tearing or dysfunction. Friction can be either longitudinal or transverse. It is helpful to include stretching and other techniques such as the active engagement methods mentioned below along with the friction treatment to encourage tissue pliability.

G. Active engagement lengthening to posterior rotator cuff muscles This technique is particularly helpful for encouraging tissue lengthening on the posterior rotator cuff tendons. It is best used in the later stages of rehabilitation or when a posterior rotator cuff injury is not severe. The client is in a prone position with the shoulder abducted to about 90° and laterally rotated as far as possible. Holding the arm in the laterally rotated position engages the lateral rotator muscles isometrically. Instruct the client to slowly drop the forearm and hand toward the floor, which causes an eccentric medial rotation. While the client is slowly moving the arm in medial rotation, perform a deep stripping technique on the infraspinatus and teres minor muscles (like that described in E above) (Fig 11.14). Perform this technique several times until the infraspinatus and teres minor have been adequately treated.

Treatments aimed at subscapularis

H. Static compression on subscapularis The subscapularis is not strained very often and the muscle is difficult to access with palpation. Static compression is used to reduce tension in the muscle to aid in healing fiber tearing or disruption. The client is in a supine position. Use one hand to hold the client's arm slightly away from their body. Use the finger tips of the other hand to

Figure 11.14 Active engagement lengthening with stripping to posterior rotator cuff tendons.

apply static compression to the subscapularis muscle (Fig. 11.5). A variation on this technique is to have the client then perform small active medial and lateral rotation movements while pressure is maintained on the muscle.

I. Deep friction on distal subscapularis Deep friction techniques can be applied to the distal fibers of the subscapularis and its musculotendinous junction, which is a likely site of a tissue tear. The client is in a supine position. Use one hand to hold the client's arm slightly away from their body. Use the finger tips of the other hand to apply deep friction to the distal subscapularis. This technique can also be performed with the thumb instead of the finger tips (Fig. 11.15).

Rehabilitation Protocol Considerations

- Determine the severity of any rotator cuff tendinosis or tear and the primary site of tissue damage prior to engaging in treatment. Do not be vigorous with deep friction techniques if a strain is recent or severe.

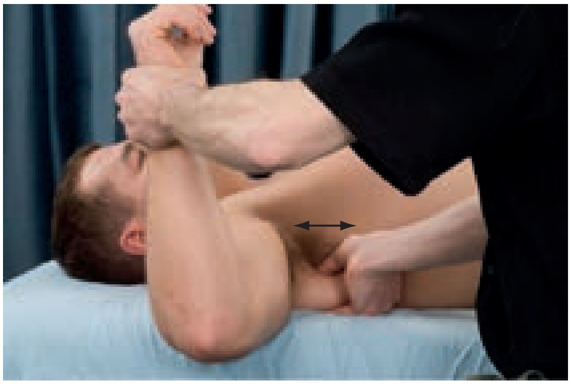

Figure 11.15 Deep friction to subscapularis (performed with thumb while other hand holds up the client's arm).

- Techniques involving active engagement during treatment should be reserved for the later stages of the rehabilitation process when the client is making progress; start with less intense techniques first.
- Stretching, joint range-of-motion techniques, and activity modifications should be a crucial component of a treatment plan. Stress on the damaged tissues must be reduced in order for soft-tissue treatment strategies to work.
- Inflammation might be present in some rotator cuff strain injuries, especially if they are acute. Topical thermal applications are not particularly helpful for supraspinatus or subscapularis injuries due to the depth of tissues, but effective for posterior rotator cuff disorders.

Cautions and contraindications Rotator cuff tears can easily masquerade as other shoulder injuries, so accurate assessment of the condition is essential. The practitioner should have a thorough knowledge of the actions of the four rotator cuff muscles. They should be able to discern when the muscles are contracting or stretching during various shoulder movements and assess which is involved in the client's present condition. It is also crucial to determine the severity of the injury as certain massage techniques would not be appropriate at particular stages of the rehabilitation process depending on the severity of tissue injury.

If the client is being treated with other methods such as physical therapy or corticosteroid injections, communicate with the other practitioners about the treatment methods you are using to ensure they work well together. If surgery has been performed for a rotator cuff tear, it is important to wait an appropriate level of time prior to administering any deep soft-tissue therapy in the area. The surgeon should be able to give advice about the appropriate length of time to wait prior to soft-tissue treatment.

SHOULDER IMPINGEMENT

Description

Shoulder impingement involves compression of several different soft-tissue structures underneath

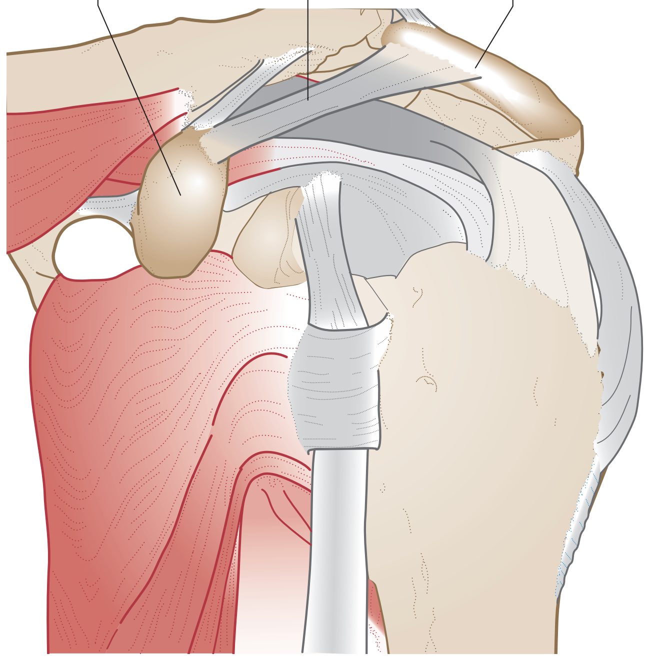

Figure 11.16 Anterior–lateral view of the shoulder showing the coracoacromial arch.

the coracoacromial arch. The acromion process, the coracoacromial ligament, and the coracoid process of the scapula create the coracoacromial arch (Fig. 11.16). Tissues susceptible to compression underneath the arch include the supraspinatus muscle or tendon, subacromial bursa, upper region of the glenohumeral joint capsule, coracohumeral ligament, and the tendon from the long head of the biceps brachii.

There are two types of shoulder impingement: primary impingement and secondary impingement. Primary impingement is characterized by a decrease in subacromial space that is the result of anatomical variations that the individual is borne with. For example, the underside of the acromion process may be flat instead of curved. This does not leave much space underneath the arch and may lead to impingement.[26] If the acromion process were tilted down at an angle instead of being more horizontal, that would also decrease the subacromial space and be a cause of primary impingement. Osteophytes or bone spurs on the underside of the acromion may also be considered a cause of primary impingement.[27]

Secondary impingement is also called acquired impingement. This type of shoulder impingement is most commonly the result of specific activities that cause compression of the subacromial tissues. For example, repeated overhead motions associated with certain swimming strokes are a frequent cause of secondary impingement. Other biomechanical or physiological factors may also lead to secondary impingement. Decreased vascularity near the supraspinatus tendon insertion may cause additional damage to these tissues when they are compressed against the acromion process.[3] Instability in the shoulder, often the result of a glenohumeral dislocation, can make the head of the humerus hit the underside of the acromion process more easily.[25] As the humerus head hits the underside of the acromion process, soft tissues are likely to be compressed causing a secondary impingent.

Shoulder impingement can occur in several stages. Neer describes three stages of impingement:[28]

1. Inflammation edema and hemorrhage – reversible with conservative treatment;
2. Fibrosis and cuff tendinitis – may be treated with conservative treatment;
3. Bony changes (spurs) – usually requires surgical intervention for tears in the rotator cuff muscles (specifically the supraspinatus).

There is often a vicious cycle of degeneration that occurs with secondary impingement. As the shoulder muscles are further impacted by the compression under the coracoacromial arch, they are much less effective at centering the humeral head in the glenoid fossa. Their inability to keep the humeral head in the glenoid fossa is a further cause of impingement during various motions.[29]

Treatment

Traditional approaches

Strengthening the associated muscles around the rotator cuff is a primary focus of early conservative treatment. This is especially true for problems of secondary impingement as opposed to primary impingement. Improper mechanical function and fatigue of certain muscles contributes to impingement. Therefore, strengthening of those affected muscles is valuable for treatment. However, care should be taken when starting a strengthening program to make sure that the exercises do not further aggravate the condition.

Oral anti-inflammatory medication or subacromial corticosteroid injections are also commonly used to address the inflammatory components of the problem. However, anti-inflammatory medication alone will not address the biomechanical dysfunction that is causing the impingement to begin with. It is most helpful if anti-inflammatory medication is used in conjunction with some other methods that address the mechanical components of the impingement. There are concerns about injecting corticosteroids into the connective tissues in this region because of long-term detrimental effects.

When conservative treatments are not effective with impingement problems, surgery is an option. As with the rotator cuff disorders discussed above, increasing space underneath the acromion process is the prime function of surgical approaches, acromioplasty is a common procedure. In this procedure, the surgeon will shave off the underside of the acromion process to either reshape it or to remove bone spurs that may be compressing soft-tissue structures.

Soft-tissue manipulation

General guidelines The effectiveness of massage interventions is directly related to how early intervention occurs in the impingement process and how severe the tissue degeneration is. Due to the anatomy and mechanics of subacromial impingement, treating this condition poses similar problems for the soft-tissue therapist as treating supraspinatus rotator cuff disorders.

Attention is focused on those tissues that may be contributing to the impingement. For example, tightness in the deltoid muscle can contribute to pulling the humeral head higher in the glenoid fossa, especially if the individual has some degree of capsular laxity. As a result, impingement problems with overhead motions of the shoulder are more likely to occur. Decreasing tightness in the deltoid muscle can reduce the impingement. It is also important to address problems with other muscles that are essential for glenohumeral mechanics as their dysfunction can play a role in the impingement problems. For example, weakness or dysfunction in the serratus anterior can decrease the amount of upward scapular rotation during shoulder abduction, leading to an increased risk of subacromial impingement.[14]

Although contributions of the subscapularis to shoulder impingement are rarely mentioned in the orthopedic literature there is evidence that the subscapularis may play a role in certain impingement problems. Myofascial treatment of the subscapularis muscle was found to be an effective aspect of treating shoulder impingement problems.[30] Static compression and other similar techniques described in the rotator cuff disorders section above are a valuable part of the treatment approach for impingement problems. If the tendon from the long head of the biceps brachii is the primary tissue being compressed under the coracoacromial arch, it should be treated to reduce the possibility of tendinosis or tenosynovitis that may develop because of the compression.

Suggested techniques and methods Treatment approaches and rehabilitation protocol considerations for shoulder impingement are the same as those described in the section above on rotator cuff disorders (especially the section on supraspinatus tears). If the biceps brachii is the primary tissue involved in the impingement, treatment techniques and rehabilitation protocol considerations are the same as those described in the section on biceps tendinosis later in this chapter.

Cautions and contraindications Use caution with pressure applied in various treatment techniques around the subacromial region with shoulder impingement. Generally, the damaged tissues are under the acromion process and not directly palpable. However, some tissues are more palpable than others. The tendon of the long head of the biceps brachii is easily accessible on the anterior region of the shoulder when it is in a neutral position. Impingement of this tendon does not occur until near the end of forward flexion. The subacromial bursa might be inflamed from impingement and it covers a large section of the humeral head. If the subacromial bursa is inflamed, direct compression techniques over the bursa are discouraged.

Box 11.2 Clinical Tip

In many cases of shoulder impingement or rotator cuff tendinosis/tears, the specific tissue that is at fault is not identified. Not knowing exactly which tissue is involved makes accurate treatment more challenging. In most cases treating these disorders with a broad spectrum of approaches is advised to be sure the primary tissue has been addressed. Additional treatment techniques are often not contraindicated. In fact, the additional treatment methods help achieve biomechanical balance. However, in some cases there are precautions to consider before embarking on a broad encompassing approach. For example in a distal supraspinatus tear or tendinosis, an ideal treatment technique would be deep friction to the affected tendon. If the subacromial bursa is involved in the same condition and inflamed, the friction treatment to the supraspinatus could be detrimental and aggravate the inflamed bursa.

SUBACROMIAL BURSITIS

Description

Bursitis in the shoulder is a common orthopedic diagnosis. Some consider it a 'wastebasket diagnosis', meaning it is used more out of convenience than for accurately labeling a condition of true inflammation in the bursa. Yet, this is a problem that can occur with frequency from excess compression underneath the acromion process, so it should be accurately evaluated.

The primary function of any bursa is to reduce friction between adjacent anatomical structures. The subacromial bursa sits on top of the supraspinatus tendon and is designed to reduce friction between the supraspinatus tendon and the overlying acromion process of the scapula (Fig. 11.17). While the bursa is very thin, it does cover a substantial portion of the humeral head underneath the deltoid muscle. The region of the bursa that extends beyond the acromion process is sometimes called the subdeltoid bursa. In some individuals, there is a division between the subacromial and subdeltoid portions of this bursa.

Subacromial bursitis results from the same mechanical factors that cause shoulder impingement problems – repetitive compression of the tissue underneath the coracoacromial arch. The pain of subacromial bursitis can be identical to that of impingement, but other factors in the assessment process help distinguish bursitis from compression of other tissues. The bursa can also be involved with other conditions involving the supraspinatus, because the inferior layer of the bursa is contiguous with the superior layer of the fascia of the supraspinatus.[31]

Bursitis is most commonly caused by repetitive compression, but there may be other causes as well. Autoimmune diseases, crystal deposition, infection, or hemorrhage may also cause an inflammatory reaction in the bursa.[32] The symptoms of these different causes can be identical, so consider these other causes of shoulder pain, especially in the absence of any clear repetitive compression pathology.

Treatment

Traditional approaches

Anti-inflammatory treatment is a mainstay for treatment of subacromial bursitis. It is important

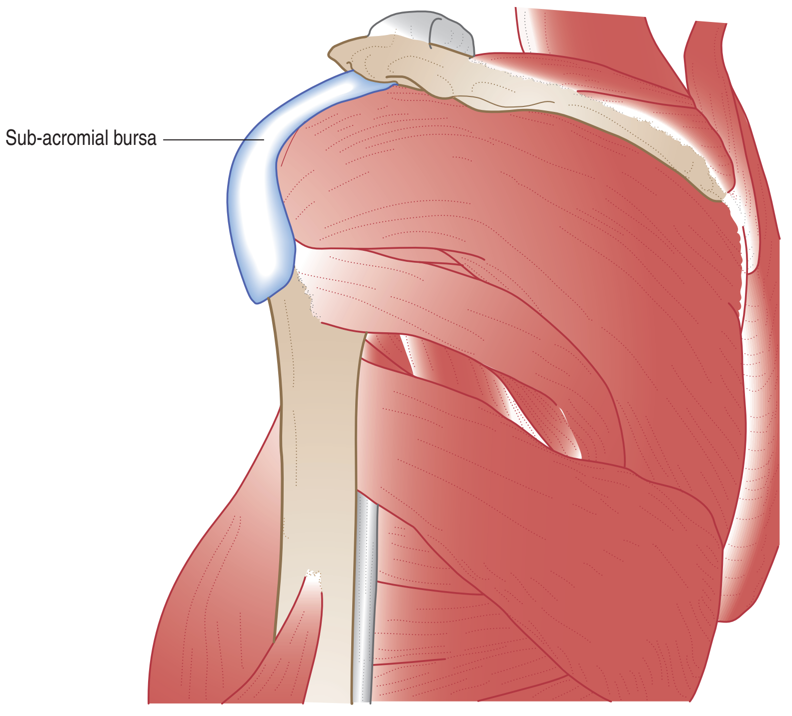

Figure 11.17 Posterior–lateral view of the shoulder showing the subacromial bursa.

to identify the factor(s) responsible for the bursa inflammation and address them as well whether that is mechanical compression or systemic dysfunction. Cryotherapy is used to address inflammatory problems. However, ice applications may have limited effectiveness because of the poor penetration depth of thermal modalities in this region. Penetration depth of thermal modalities is limited because the acromion process is between the cold application and the subacromial bursa.

Other anti-inflammatory measures are used more often because of limited effectiveness with cryotherapy. Oral NSAIDs are commonly used to treat this problem. There may be detrimental long-term effects of their use, however.[33] NSAIDs also have a range of adverse side effects. For example, gastrointestinal disturbances are reported from long-term use of NSAIDs.[34–37]

Corticosteroid injections are sometimes used an alternative to oral anti-inflammatory medications. These injections are helpful for reducing inflammation in the bursa. However, there are significant concerns about the long-term use of corticosteroid injections because of their detrimental effect on soft tissues. NSAIDs or corticosteroid injections are not used to heal these injuries but instead are used to reduce symptoms so that clients can engage in rehabilitation activities more fully. Recommendations are no more than three corticosteroid injections in a 12-month period, and these are best spaced at least 30 days apart.[32]

Rotator cuff strengthening programs are used to normalize biomechanical balance in the shoulder girdle. Strengthening exercises should not be performed to the point that there is any aggravation of the pain. Continual exertion that makes the pain worse can exacerbate the problem.

Heat treatment is not an approach that would usually be indicated for an inflammatory condition like bursitis. However, heat application may reduce associated tension in the surrounding shoulder muscles. A local heat application does not appear to aggravate the inflamed bursa in some cases because the heat cannot penetrate the acromion process in order to have an effect on the subacromial bursa.

Soft-tissue manipulation

The bursa becomes aggravated from excessive friction or pressure, so massage treatment on the bursa is contraindicated. The primary goal of the soft-tissue practitioner is reducing any causative factors that might have led to compression of the bursa. For example, muscle tension in surrounding shoulder muscles could be one causative factor in the condition, so treatment of these muscles is beneficial. Any of the massage treatment techniques for the shoulder can be used to address muscle imbalance that may be contributing to the subacromial bursitis. No treatments should be used that aggravate the symptoms from the inflamed bursa.

BICIPITAL TENDINOSIS

Description

Bicipital tendinosis is a condition affecting the tendon from the long head of the biceps brachii. The tendon from the long head travels along the anterior aspect of the arm and between the greater and lesser tuberosities of the humerus (Fig. 11.18). A synovial sheath surrounds the tendon as it passes between the two tuberosities and the tendon is stabilized in the bicipital groove by the transverse humeral ligament. The tendon eventually courses through the glenohumeral joint capsule before attaching to the glenoid labrum and the superior aspect of the glenoid fossa on the supraglenoid tubercle.

As mentioned previously, the common overuse tendon pathologies are now more appropriately called tendinosis rather than tendinitis because they are rarely inflammatory conditions, though tendinitis is still frequently used.[38] A typical symptom with bicipital tendinosis is anterior shoulder pain that is worse during forward flexion of the shoulder. In this position, the tendon can be squeezed under the coracoacromial arch. The pain will usually decrease with rest.

The primary cause of irritation is friction of the tendon in the bicipital groove or underneath the coracoacromial arch. This usually occurs from repeated movements involving shoulder flexion or forearm supination. In some cases friction may be increased because the groove is particularly narrow.[39] The friction leads to collagen degeneration in the tendon and subsequent pain. Because of the synovial sheath surrounding the tendon, tenosynovitis could also be the cause of pain from bicipital tendon overuse.

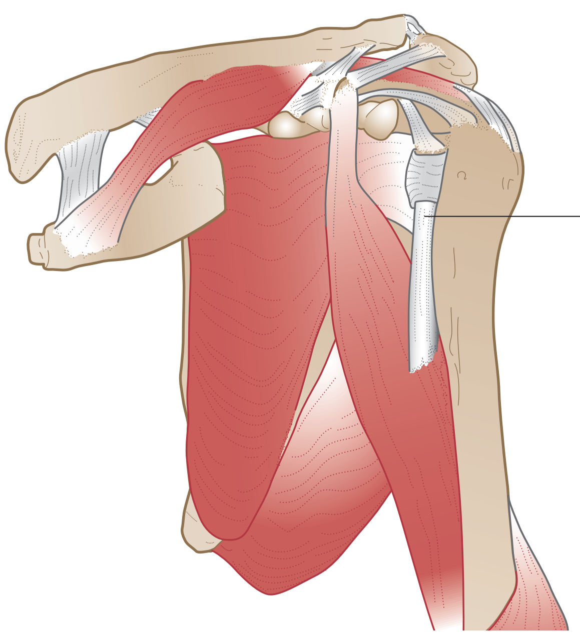

Figure 11.18 Anterior–lateral view of the shoulder showing the tendon from the long head of the biceps brachii.

If the transverse humeral ligament is not sufficient to keep the tendon in its groove, the tendon may sublux out of the groove in certain shoulder motions. The tendon could also sublux or dislocate because the tuberosities are smaller than normal and cannot hold the tendon as easily within the groove.[40,41] Repeated friction across the tuberosities as the tendon moves in and out of the groove can cause tendinosis.[42]

Treatment

Traditional approaches

Anti-inflammatory medications remain a mainstay of treatment for bicipital tendinosis. However, the effectiveness of this approach is questionable because in many cases this is not an inflammatory condition. Restoring proper flexibility and biomechanical balance around the region will be of prime importance. Stretching exercises are recommended to increase flexibility. It is also essential that any offending activities be reduced or eliminated.

The biceps brachii has three primary actions: shoulder flexion, elbow flexion, and forearm supination. Therefore, repetitive motions in any of these directions could cause an excess amount of tendon irritation. Any strength training activities undertaken during the early rehabilitative phase should avoid excessive use of those motions for that reason.

Use of thermal treatments is advocated by various sources, but they appear only moderately effective. Cold applications are used to reduce inflammatory reaction in the tissues. However, the lack of inflammation in most cases of bicipital tendinosis decreases the need for cold therapy. The greater benefit of cold applications is their use for pain reduction.

Heat applications that would normally be contraindicated for an inflammatory condition can be used effectively for this condition. Heat reduces overall muscular hypertonicity and decreases pain as well. Keep in mind that a true inflammatory tendinitis can exist. If it does, heat applications are not advised. Khan et al provides a comparison of tendinosis and tendinitis which is useful for determining if a true inflammatory condition exists.[43]

Soft-tissue manipulation

General guidelines Massage treatment for bicipital tendinosis focuses on the primary tissue pathology (tendon degeneration), as well as the various contributing musculoskeletal factors such as overuse of the shoulder muscles. There are several goals of treatment. Tendinosis results from excess tension on the tendon; an important goal is to reduce tension on the biceps brachii, which is pulling on the tendon. A variety of massage techniques such as sweeping cross fiber, deep longitudinal friction, and active engagement methods are used to treat the biceps brachii tension. It is also crucial to address the collagen degeneration in the bicipital tendon. Deep friction is used to encourage fibroblast proliferation and encourage collagen synthesis to heal the damaged tendon structure.[44,45]

Treatment of bicipital tendinosis with friction massage is usually applied in a medial–lateral direction. However, if the client has a bicipital groove that is narrow, deep friction administered in a medial–lateral direction could catch the edge of the tendon and cause subluxation of the tendon out of the bicipital groove. This is a situation where a longitudinal friction technique is most beneficial.

Suggested techniques and methods

A. Sweeping cross fiber to biceps brachii Tension reduction in the biceps brachii reduces tension on the bicipital tendon. Apply sweeping cross fiber techniques to the biceps brachii (Fig. 11.19). This technique can be performed with the client's elbow flexed, which keeps the biceps in a shortened position and more pliable.

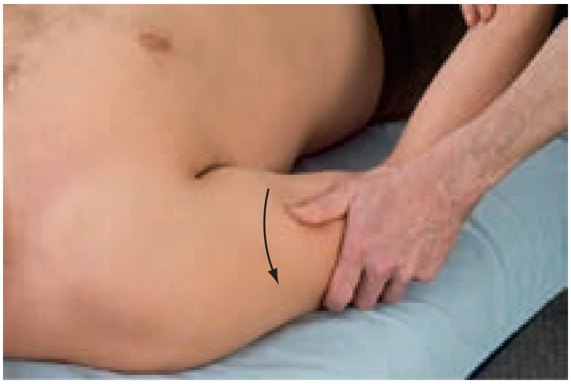

Figure 11.19 Sweeping cross fiber to the biceps brachii.

However, greater muscle tension reduction and fiber spreading is accomplished by applying the sweeping cross fiber technique with the elbow extended so the muscle is in a lengthened position.

B. Deep longitudinal stripping to biceps brachii This technique is an effective means to increase pliability and reduce tension in the biceps brachii. It is most effective when performed after initial therapy begins to increase tissue pliability. With the client's elbow extended, apply deep longitudinal stripping techniques to the biceps brachii working from its distal attachment toward the proximal end. A broad application of pressure can be used initially for more general work. Use a small contact surface of pressure application, such as the thumb or finger tip, to specifically treat the biceps (Fig. 11.20). The muscle belly is not that large on the majority of people so a great deal of pressure is not necessary. Because the proximal tendon is the most common site of tendinosis, the longitudinal stripping technique can trace the path of the muscle fibers and on to the tendon, following the tendon all the way to the shoulder joint. Perform repeated longitudinal strokes on the biceps brachii until the entire muscle has been treated. Keep in mind that the median nerve is running along the biceps brachii, so be cautious about pressing nerve tissue against the underlying bone (the client will likely report sharp neurological sensations).

C. Active engagement shortening Working on the biceps brachii while it is under active contraction magnifies the effect of the pressure applied. The client is in a supine position and is instructed to perform a repeated elbow flexion and extension movement at a moderate pace. During the shortening phase of elbow flexion, a compression broadening technique is applied to the biceps with the thumbs or thenar eminence of the hand (Fig. 11.21). The broadening technique during elbow flexion is performed repeatedly until the entire muscle is covered.

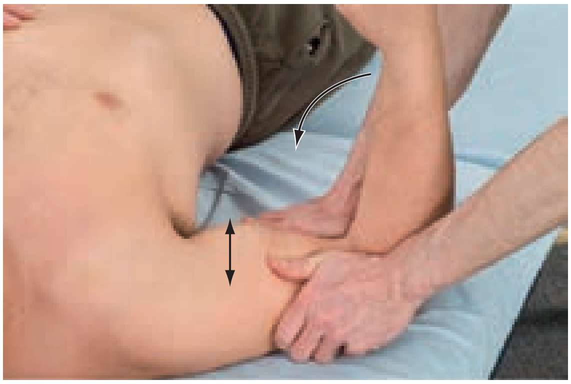

Figure 11.21 Active engagement shortening to biceps brachii.

D. Pin and stretch for biceps brachii Tissue elasticity and pliability is enhanced with pin and stretch techniques to the biceps brachii. The client is in a supine position with the elbow flexed. Grasp the client's distal forearm with one hand while your other hand applies pressure to the biceps with a fingertip or thumb. Pull the client's forearm into full elbow extension while maintaining pressure on the biceps (Fig. 11.22). This technique can be repeated in several places along

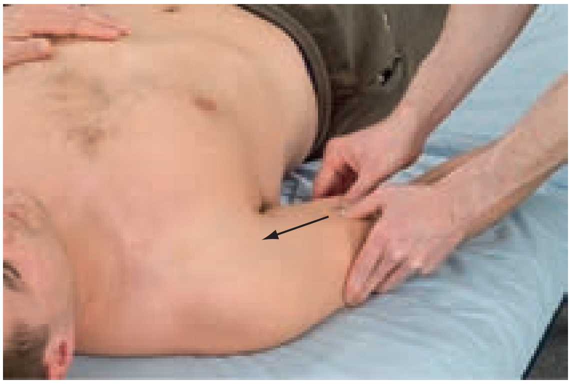

Figure 11.20 Deep stripping on biceps brachii.

Figure 11.22 Pin and stretch for biceps brachii.

the belly of the biceps. The technique is designed to enhance elongation of the sarcomeres in the muscle fiber, so it is not as effective if applied to the tendon itself.

E. Active engagement lengthening with additional resistance The greatest effects of muscle tissue lengthening result from active engagement lengthening techniques. The client is in a supine position. One hand grasps the client's distal forearm, just as in D above. With the client's elbow flexed instruct the client to hold that position while you attempt to pull the forearm into extension. This establishes an initial isometric contraction in the biceps. Once the initial contraction level is established, instruct the client to slowly release the contraction while the client's forearm is pulled into extension, while simultaneously performing a deep longitudinal stripping technique on the biceps (Fig. 11.23). Repeat this whole process until the entire muscle has been adequately covered.

F. Deep friction to the biceps tendon Perform deep friction treatments to the tendon of the biceps brachii. The tendon is likely to be tender, so adjust pressure levels to the client's comfort tolerance. Transverse friction applied to the biceps long head tendon could possibly cause subluxation of the tendon (out of the groove), especially if the greater or lesser tuberosities are not very large. Avoid this adverse outcome by performing deep friction techniques longitudinally on the tendon instead of transversely (Fig. 11.24).

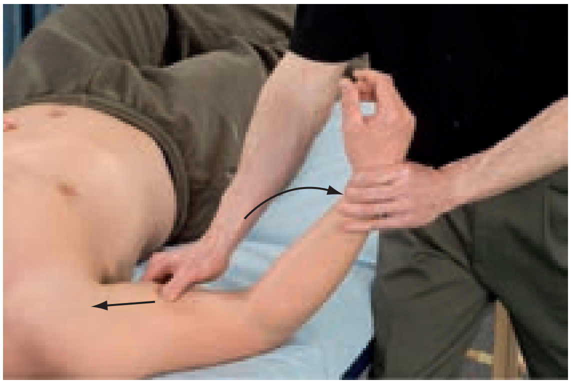

Figure 11.23 Active engagement lengthening with stripping to biceps brachii.

Figure 11.24 Deep friction to biceps tendon long head.

Rehabilitation protocol considerations

- Tendinosis treatment is built on a multi-pronged approach to treatment including reduction of muscle tension, rest from offending activities, and stimulation of fibroblast activity to heal damaged tendon fibers. Stretching approaches are helpful throughout all phases of treatment.
- Thermal applications, such as ice or moist heat, are effective when used in conjunction with the massage approaches mentioned above. Moist heat is helpful in reducing tension in the muscle tissue and enhancing soft-tissue pliability. Cold applications are helpful to reduce any discomfort associated with the deep friction techniques that are applied directly to the affected tendon fibers.
- Techniques such as the active engagement broadening or lengthening may be too intense for a person with a more aggravated tendinosis condition. These techniques can be reserved for a later stage in the rehabilitation process. If the condition is not severe initially, these techniques can be started immediately and adjusted to the client's comfort level and outcome goals.
- Rebuilding the collagen matrix of damaged tendons is a slow process. Encourage the client that persistence in treatment pays off and in the mean time reduction of offending activities is crucial for healing.

Cautions and contraindications Anti-inflammatory medication is effective at reducing the client's pain in tendinosis conditions. Deep friction massage is frequently given with a pressure level that is close to the pain threshold. If the client is currently taking pain medication, consider reducing the pressure level in friction massage treatments because the client might have an altered pain threshold. As mentioned above, use care when performing friction techniques to the bicipital tendon near the bicipital groove. Transverse friction that is performed vigorously could cause subluxation of the bicipital tendon. Performing deep friction techniques longitudinally on the tendon avoids this potential problem.

Box 11.3 Clinical Tip

There are three main tendons for the biceps brachii. The two proximal tendons include the long head attaching at the supraglenoid tubercle and the short head attaching at the coracoid process. The distal tendon from the muscle belly attaches on the radius. Tendinosis rarely affects the distal tendon or the tendon from the short head. The long head tendon travels over the top of the humeral head and through the bicipital groove. These bony mechanical obstructions in the tendon's path are what primarily contribute to the tendinosis. The tendon is also encased in a synovial sheath as it travels through the bicipital groove and is, therefore, susceptible to tenosynovitis.

Deep friction is a primary treatment method for both tendinosis and tenosynovitis, but for different reasons. In tendinosis, friction is valuable because it helps stimulate fibroblast activity for collagen repair in the damaged tendon. In tenosynovitis, the friction treatment helps break fibrous adhesions between the tendon and its surrounding synovial sheath.

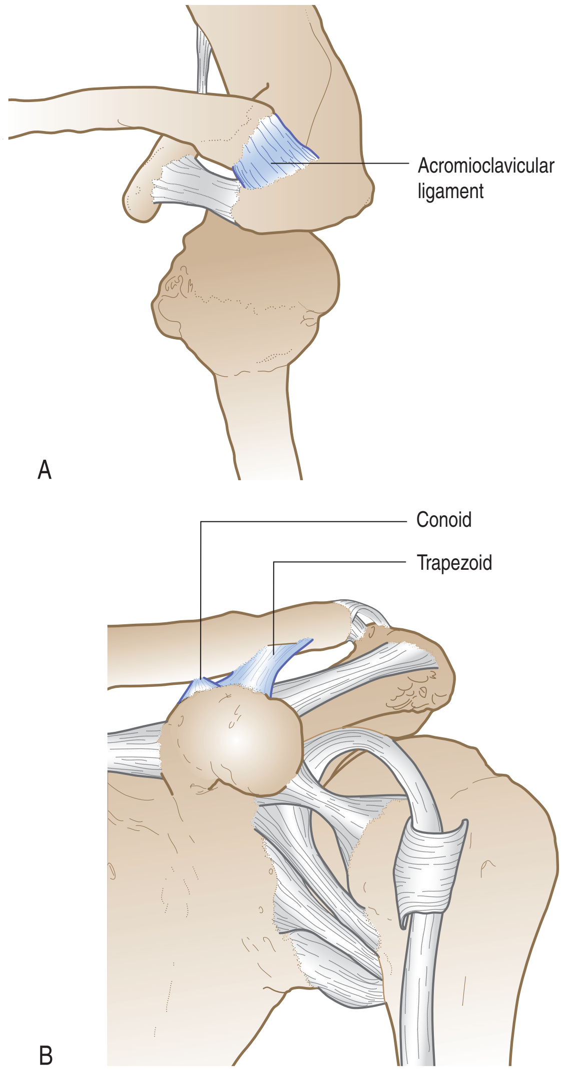

Figure 11.25 (a) Superior view of the shoulder showing the acromioclavicular ligament, (b) anterior view showing the two parts of the coracoclavicular ligament.

SHOULDER SEPARATION

Description

A shoulder separation is a sprain injury to the ligaments of the acromioclavicular joint. This occurs most often from a direct blow on the shoulder, for example when a person falls on the ground and lands directly on the anterior/lateral shoulder region or if something falls directly on the lateral shoulder region. There are three primary ligaments that can be injured in a shoulder separation: the acromioclavicular ligament, and the two parts of the coracoclavicular ligament called the conoid and trapezoid (Fig. 11.25). It is not difficult for these ligaments to sustain injury as they are thin and not very strong.

The acromioclavicular ligament is designed to provide anterior/posterior and mediolateral stability. The coracoclavicular ligaments are designed to provide stability against vertical forces. Surrounding muscles and fascia provide additional support for the joint as well. Fibers of the upper trapezius and deltoid muscles insert near this region and lend some additional structural support.[3]

Shoulder separations are divided into three categories, depending upon the particular tissues that are damaged:

- Type 1: there is no fiber disruption to any of the three ligaments, but some degree of ligament stretching.
- Type 2: there is a disruption to the acromioclavicular ligament but the coracoclavicular ligaments are intact.
- Type 3: there is disruption to both the acromioclavicular and coracoclavicular ligaments.

A direct impact blow to the anterior lateral shoulder region usually causes this injury, but any traumatic injury to the shoulder can cause enough mechanical stress on the acromioclavicular articulation to sprain the ligaments. Impact to the clavicle could also cause a compression injury to the neurovascular structures that pass between the clavicle and the first rib. See the discussion of thoracic outlet syndrome for more information about this condition. Other common causes of sprain to the acromioclavicular joint involve falling on an outstretched arm or severe distraction of an abducted arm.[26]

Treatment

Traditional approaches

The primary goal in treating a ligament sprain is to protect the joint against excess motion and to help the damaged ligament tissue heal. Ice and NSAIDs are used as anti-inflammatory treatments for mild sprains. An arm sling is routinely used to keep the area relatively immobile so the ligament can heal properly. However, overuse of the sling can cause problems with excessive fibrosis and development of adhesive capsulitis. To prevent this from occurring early protected motion is a primary treatment goal if the sprain is not severe. Range of motion exercises are gradually incorporated after the sling is no longer being used.

Shoulder separations are generally treated non-surgically even if there is a Type 3 sprain. The Type 3 sprain is likely to leave a cosmetic deformity (protruding clavicle), but there is no strong evidence that surgery for this problem is necessary in many cases.[26] However, each situation is unique, and there are situations where a Type 3 shoulder separation may need surgical intervention. Therefore, it is important to have the condition properly evaluated by a physician to determine if surgery is necessary.

One of the rehabilitation challenges following ligament injury is how to regain stability in the joint when ligaments have been stretched and do not return to their original length. Prolotherapy is a treatment option that is sometimes used in this situation. This treatment involves injection of a dextrose solution into the damaged ligament fibers to stimulate healing of the ligament. In many cases, the injection is able to cause the ligament fibers to heal and tighten to some degree.

Soft-tissue manipulation

General guidelines Damage to the ligaments of the acromioclavicular joint requires time and protection from additional stress to allow adequate ligament tissue healing. Friction massage is used to stimulate healing properties in tendon and ligament tissue, although adequate studies still need to be performed with human subjects.[46] After the acute stage of the injury has passed (usually after about 72 hours), friction massage of the damaged ligaments can begin. The amount of pressure and length of time the friction massage is applied depends on the severity of the injury and the client's pain tolerance. In general, the rule is – the more recent the injury, the shorter the duration of treatment.

One of the more important roles for the massage practitioner in helping to manage a shoulder separation is preventing excess fibrotic activity in adjacent tissues. This is especially important if the individual is wearing a sling, as prolonged immobilization can lead to tissue fibrosis, especially in the glenohumeral joint capsule. A variety of techniques including sweeping cross fiber and deep longitudinal stripping techniques are valuable to maintain shoulder motion and decrease muscle tension that limits mobility.

Secondary adhesive capsulitis can develop after a shoulder separation, especially if the region is held immobile for long periods. Therefore, it is helpful to encourage range of motion gains, especially in external rotation and abduction, as long as treatment is within the client's pain and comfort tolerance. Some of these motions can cause pain or discomfort at the acromioclavicular joint due to the sprain, so move slowly and cautiously through range-of-motion activities.

General massage to the shoulder girdle is also important. Acute injuries, such as a shoulder separation can produce hypertonicity in numerous muscles around the shoulder. Hypertonicity in these muscles can cause myofascial trigger points or biomechanical imbalance and lead to other soft-tissue dysfunctions. Massage is one of the most effective means of decreasing the compensatory patterns of muscular dysfunction.

Suggested techniques and methods

A. Myofascial release of shoulder region The subtle myofascial techniques can help reduce overall muscle tension around the shoulder and encourage proper healing of the sprain at the acromioclavicular joint. Fascial techniques are applied in multiple planes to provide the greatest mobility enhancement. The primary goal is to place a moderately light tangential (tensile) force on the subcutaneous fascia. Pulling the fascia in multiple directions enhances its pliability the most. Place the hands lightly on the client's shoulder region where the myofascial stretch is to be applied. The practitioner pulls their hands apart to take the slack out of the tissue and to apply a light degree of tensile (pulling) force between the hands (Fig. 11.1). Once there is a slight degree of pull between the hands, the position is held until a subtle sensation of tissue release is felt between the hands. This technique can be applied in various regions of the shoulder, but emphasize the tissues of the anterior shoulder region.

B. Sweeping cross fiber to anterior chest muscles Treatments aimed at the anterior chest muscles help reduce limited motion in the shoulder and reduce tension in shoulder girdle muscles near the acromioclavicular joint. Stand at the head of the table facing the client's feet with the fingers anchored in the client's axilla. Use the thumb to perform sweeping cross fiber movements on the pectoralis major (Fig. 11.2). During the sweeping motion the pectoralis major is sifted between the fingers. Similar sweeping cross fiber techniques can be applied to the anterior deltoid while facing in the same position (toward the client's feet).

C. Deep stripping on pectoralis major Use the thumbs, finger tips, or pressure tool to perform deep stripping techniques to the pectoralis major. Treatment can move from medial to lateral or lateral to medial (Fig. 11.4). Variations on this technique, such as pin and stretch can also be used, especially in the later stages of treatment when the joint is more stable and significant ligament healing has occurred.

D. Deep stripping to proximal fibers of the supraspinatus Muscles near the acromioclavicular joint, such as the supraspinatus, can become tight following a shoulder separation. Stripping techniques on the supraspinatus reduce tension in this muscle. The client is in a prone position. Place the thumb or finger tip anterior to the trapezius and on the proximal fibers of the supraspinatus near the vertebral border of the supraspinous fossa. Perform a slow deep stripping technique on the supraspinatus muscle to encourage tissue lengthening and reduction of muscle tightness (Fig. 11.8). This technique could also be performed in other positions if those are more comfortable for the client.

E. Deep stripping on the upper trapezius The trapezius attaches to the distal clavicle and tension in the trapezius after the sprain can put adverse tension on the joint. Deep stripping can help normalize trapezius tension and decrease any biomechanical dysfunction resulting from the injury. The client is in a prone or side-lying position. After sufficient warming techniques such as effleurage and sweeping cross fiber, perform a longitudinal stripping technique on the upper trapezius. Begin with the fibers in the cervical region and follow the lateral edge of the trapezius out to its attachment on the distal clavicle near the acromioclavicular joint (Fig. 11.26). Perform these stripping techniques repeatedly until the entire upper trapezius has been addressed.

F. Deep friction to the ligaments of the acromioclavicular joint Ligament healing is enhanced with deep friction techniques applied to the damaged fibers. Friction can be applied in multiple directions to create the greatest pliability of the

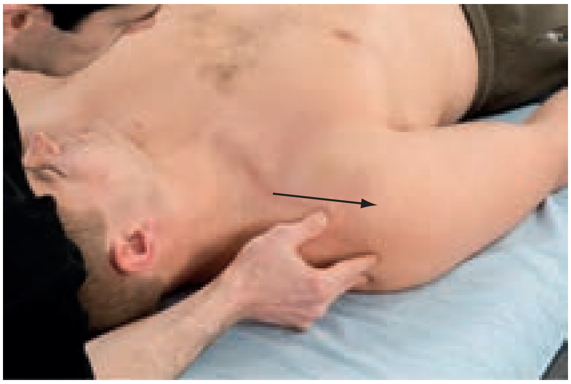

Figure 11.26 Deep stripping on lateral border of upper trapezius.

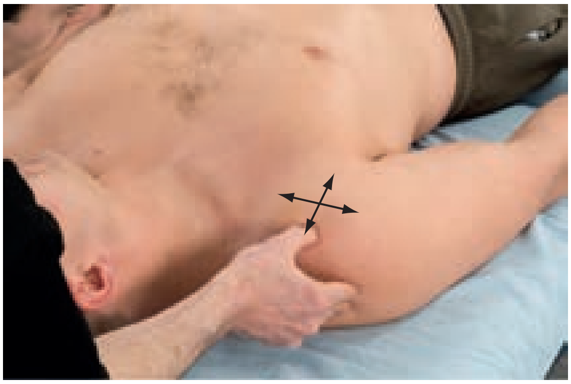

Figure 11.27 Deep friction to the acromioclavicular ligaments injured in shoulder separation.

healing ligament tissue. Apply the deep friction with the finger tips or thumb (Fig. 11.27). Gentle range-of-motion movements can be incorporated with the friction to aid in mobilization of the healing tissue. Motions that should be stressed in these movements include scapular elevation and depression along with horizontal adduction and horizontal abduction. These are the movements that mobilize the acromioclavicular joint the most.

Rehabilitation protocol considerations

- Accurate orthopedic assessment is important to determine the severity of the A–C joint sprain. Some treatment techniques will be modified depending on the severity of the sprain. Deep friction should not be performed directly on the damaged ligaments in a severe sprain or one where there is excessive joint mobility. If there is a Type 3 shoulder separation it is more appropriate to wait a little farther into the healing process before beginning direct friction techniques. Use the client's pain and comfort tolerance as a guide and do not perform friction massage on any injury that is highly painful. A moderate degree of discomfort is common with treatment of any ligament sprain, but avoid treatments that cause a significant pain increase.
- Strength training is sometimes used as an adjunct treatment in rehabilitation of ligament sprains. If exercise is started too early, it can put additional stress on the joint and further aggravate the injury. Strength training should not begin until the later stages of the rehabilitation.
- In the early stages of the injury focus should be on the surrounding muscles and treating the site of ligament injury with short durations of friction. As the injury rehabilitation progresses, increase the time spent working directly on the ligament tear site with vigorous friction.

Cautions and contraindications Use caution with any techniques or movements that put pressure on or cause movement to the acromioclavicular joint. Pain is an appropriate guide to determine if too much pressure or movement is aggravating the injury. Try not to put too much pressure on the distal end of the clavicle when applying friction techniques to the acromioclavicular joint. This will minimize movement of the clavicle while the ligaments spanning the joint are attempting to heal. If the sprain is severe enough to cause displacement of one end of the clavicle, there may be compression of neurovascular structures in the area so watch for any signs or symptoms that would indicate compression of these tissues.

GLENOHUMERAL DISLOCATION/ SUBLUXATION

Description

The shoulder has the greatest range of motion of any joint in the body. To have this great range, there is very little bony limitation to movement in any direction. As a result, movement restraint at the glenohumeral joint primarily comes from soft tissues. Muscles, along with the ligaments and joint capsule, provide the greatest limitation to excess motion. Because the glenoid fossa is so shallow, the head of the humerus is susceptible to dislocation at this joint.

A rim of cartilage called the glenoid labrum surrounds the glenoid fossa. This cartilage rim helps make the fossa slightly deeper to protect against dislocations. When dislocations do occur they are usually anterior dislocations.[47] In anterior dislocations the head of the humerus is thrust in an anterior direction relative to the glenoid fossa. Anterior dislocations usually occur from the combined motions of shoulder abduction and external rotation.

The joint capsule is contiguous with numerous ligaments that span the glenohumeral joint. However, anatomists have chosen to name some of these ligament structures separately. One of the most important ligament structures for resisting glenohumeral dislocation is the inferior glenohumeral ligament, which is the primary restraint to anterior glenohumeral dislocation (Fig. 11.28).[48] This ligament is pulled or stretched beyond its capacity in anterior dislocations.

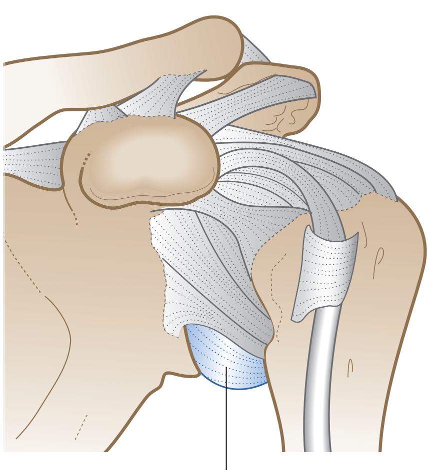

Figure 11.28 The inferior glenohumeral ligament.

The inferior glenohumeral ligament attaches to the lower border of the glenoid labrum. With excessive tensile stress it may pull the labrum away from the rim of the glenoid fossa, producing an injury called a Bankart lesion. The Bankart lesion accompanies anterior glenohumeral dislocations, and is a problem that must be addressed once the actual dislocation has been resolved.

Another soft-tissue structure that plays an important role in preventing anterior dislocations is the tendon from the long head of the biceps brachii. This tendon attaches to the supraglenoid tubercle and has fibers that insert into the upper region of the glenoid labrum. The angle of the tendon is such that it comes across the anterior aspect of the humeral head, and helps prevent anterior dislocations of the humerus.[49]

In a situation where an anterior dislocation has occurred, the biceps tendon may put enough tensile (pulling) stress on its attachment site at the supraglenoid tubercle to pull the labrum away from the glenoid fossa. This injury is called a SLAP lesion (superior labrum anterior posterior). It indicates a tear to the superior aspect of the labrum oriented in an anterior to posterior direction. If a SLAP lesion has occurred the biceps brachii is usually less effective in holding the humeral head in its proper position.[50,51] With a decrease of glenohumeral stability from the biceps, there is increased instability in the joint, and future dislocations are even more likely.

Instability is one of the prime factors that both causes and results from dislocations. For example, when a dislocation or subluxation has occurred, the ligaments and joint capsule are further stretched. Once these structures are stretched, the head of the humerus more easily moves around in the glenoid fossa creating joint instability. The more instability in the joint, the greater is the chance of future dislocations.

There are several other problems that result from shoulder instability or glenohumeral dislocation. Continued instability in the shoulder can cause osteoarthritis as the client gets older.[52] Shoulder impingement syndrome or rotator cuff disorders are likely to occur as well. When the humeral head is moving around more in the glenoid fossa, there is a greater chance for it to press the soft tissues that are above it against the underside of the acromion process or the coracoacromial ligament. Subsequently, damage to the supraspinatus, joint capsule, biceps tendon long head, or subacromial bursa may result.

Treatment

Traditional approaches

Restoring a dislocated joint to its proper position is called reducing the dislocation. If a dislocation is serious and has to be reduced, it should only be done by someone who is qualified and trained to reduce dislocations. Serious injury can result by attempting to correct a dislocation if it is performed improperly. The brachial plexus and axillary artery are very close to the lip of the glenoid labrum. If, in attempting to move the humeral head back into the glenoid fossa, the practitioner pinches the brachial plexus or axillary artery between the humeral head and the rim of the glenoid labrum, these neurovascular structures can be severed. In some cases reduction of the dislocation is performed under anesthesia so there is very little muscular resistance to the movement.

Once the dislocated joint has been properly restored to its correct position, attention shifts to the problem of instability and capsular ligament stretching that can cause further complications. If the instability is mild, strengthening of the muscles surrounding the shoulder is initiated so they can aid in glenohumeral stability. Strengthening procedures focus on the rotator cuff, trapezius, and serratus anterior muscles. Any strengthening motions that go near the position of instability are avoided. In addition, strengthening does not emphasize muscles that increase the pull of the humeral head in the unwanted direction. For example, strength training for the pectoralis major is discouraged in an anterior dislocation because it may pull the humeral head in an anterior direction.

If the dislocation is severe, or conservative approaches have been unsuccessful, surgery is an option. A common surgical procedure for dislocations is the capsular shift. In this procedure, an incision is made in the ligamentous capsular tissues and they are pulled up and stitched over one another making a tighter capsule.[27]

A newer procedure that has been gaining interest is thermal capsulorrhaphy. In this procedure, the physician uses a small heat probe with either laser energy or radio frequency generated heat to shrink the capsule and improve stability. Many surgeons have been using this procedure and obtaining good results, although the long-term effectiveness has not yet been determined.[53–56]

Soft-tissue manipulation

General guidelines Massage treatment by itself is not going to restore a dislocated or subluxed joint. However, massage can make a beneficial contribution to treating these disorders. Once the dislocation has been reduced (corrected), massage can aid in the return of proper biomechanical balance and reduction of muscular splinting in the region.

Massage can also be used to target hypertonicity in any muscles that could pull the humeral head in an unwanted direction. For example, various massage techniques to the pectoralis major may help reduce its contribution to further anterior translation of the humeral head.

Reducing other secondary problems such as shoulder impingement resulting from instability is also a goal of massage treatment in this condition. Dislocations could produce excess tension on the tendon from the long head of the biceps brachii, and further aggravate labral damage. Tendon dysfunction, such as bicipital tendinosis or tenosynovitis could also result and massage can be used to address those issues.

Suggested techniques and methods Massage treatments for this condition are not aimed at correcting the dislocation or subluxation. However, hypertonicity or biomechanical dysfunction in muscles of the shoulder can further exacerbate problems resulting from the shoulder instability. The following techniques are helpful in addressing these secondary issues.

A. Sweeping cross fiber to anterior chest muscles Treatments aimed at the anterior chest muscles help restore proper biomechanical balance that can be altered from the dislocation or subluxation. This technique helps reduce tension in superficial fibers of pectoralis major and anterior deltoid. Stand facing the client's feet with the fingers anchored in the client's axilla. Use the thumb to perform sweeping cross fiber movements on the pectoralis major (Fig. 11.2). During the sweeping motion, the pectoralis major is sifted between the fingers. Similar sweeping cross fiber techniques can be applied to the anterior deltoid while facing in the same position (toward the client's feet).

B. Deep stripping on pectoralis major Use the thumbs, finger tips, or pressure tool to perform deep stripping techniques to the pectoralis major. Treatment can move from medial to lateral or lateral to medial (Fig. 11.4). Variations on this technique, such as pin and stretch, can also be used to make pressure penetration more effective. However, use caution with the position of the shoulder during any movement or massage techniques to make sure they do not move close to positions of shoulder instability.

C. Deep stripping on infraspinatus and teres minor Posterior rotator cuff muscles may also be under increased tension as a result of the dislocation. Deep stripping helps normalize tissue tightness in this muscle group. With the thumb or fingertips, apply a deep longitudinal stripping technique from the proximal to distal fibers of the infraspinatus and teres minor (Fig. 11.12). Continue the stripping technique until all the fibers of the infraspinatus and teres minor have been treated. This technique can also be performed in a distal to proximal direction, if a more comfortable hand position is desired.

D. Sweeping cross fiber to biceps brachii Tension reduction in the biceps brachii reduces tension on the bicipital tendon and can help restore proper mechanics of the glenohumeral joint following a dislocation. Apply sweeping cross fiber techniques to the biceps brachii (Fig. 11.19). This technique can be performed with the client's elbow flexed, which keeps the biceps in a shortened position and more pliable. However, greater muscle tension reduction and fiber spreading is accomplished by applying the sweeping cross fiber technique with the elbow extended so the muscle is in a lengthened position.

Numerous other techniques applied to the shoulder region described in this chapter can be helpful in restoring proper biomechanical balance around the joint.

Rehabilitation protocol considerations

- If a shoulder dislocation is suspected it is advisable to get guidance from a physician about the level of instability remaining in the shoulder. The shoulder should be considered highly vulnerable to movement or stretching techniques, especially those involving abduction and lateral rotation.
- Tension reduction in muscles is usually a primary goal of massage treatments. However, in a severe dislocation there may be some advantages in muscle tension around the joint as it can preserve joint stability and prevent further damage from the excess mobility.
- If there is an injury to the superior labrum along with the dislocation, any strength training activities involving the biceps brachii should be avoided until the labral damage has been addressed. Further use of the biceps brachii with strong resistance could further damage the superior labrum.

Cautions and contraindications After a subluxation or dislocation, the body's proprioceptors strongly warn when a position or movement is coming near the position of instability. The client usually feels apprehension and/or discomfort with the motion. Be sure to watch for apprehension signs that indicate movement or positions that could jeopardize joint stability. Also use caution with range-of-motion techniques that push the humeral head against the edge of the glenoid labrum due to possible glenoid labrum damage.

Box 11.4 Case Study

Background

Sandra is a 46-year-old hair stylist with a large clientele. Two weeks ago she slipped on a wet floor in her salon and put her arm out behind her to break her fall as she fell backward. She did not break anything in the fall, but hurt her wrist in the accident as well as her shoulder. The wrist pain has since decreased, but she is having increasing discomfort in her shoulder, especially at the end of the day at work. She is also noticing that the shoulder pain is increasingly interrupting her sleep. The shoulder pain is a dull aching sensation and the pain is localized in her shoulder but also extends down her arm somewhat. This condition is making it increasingly difficult for her to perform her long days of work in the hair salon.

She saw her physician after the injury and confirmed that there were no broken bones from the accident. However, the shoulder pain was not that prominent at the time. She has not been back to see the physician again about this shoulder complaint. She is an active yoga practitioner and has tried some stretching and yoga for the shoulder problem, but this does not seem to be resolving the problem.

Questions to consider

- Sandra's shoulder pain seems to be worse now than right after her initial injury. Why might the pain be more serious now?
- Based on the mechanics of the injury and the few symptoms she has described, do you think she has injured any neurological structures in her shoulder?
- Now that she is several weeks post injury but experiencing some increasing shoulder pain do you think any thermal modalities, such as moist heat or ice would be helpful for her shoulder? Why or why not?
- If Sandra's condition turns out to involve shoulder impingement that is being aggravated by the position of her arms at work, would you want to treat this with massage?
- If the initial injury caused a supraspinatus rotator cuff tear, should this be treated with massage? If so, how often would massage treatment be helpful. If not, when would it be appropriate to begin massage treatment?
- What else can Sandra do along with massage treatment to decrease stress on this region during her daily activities?

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Chapter 12

Elbow, forearm, wrist and hand

CHAPTER CONTENTS

The lower extremities are the limbs of motion, but the upper extremities are the limbs of activity. Whether it is occupational or recreational activity or simply going through the motions of daily living, much of each day involves using the hands. The human hand is designed for precise manipulation of objects, which means there is a fine degree of neuromuscular control. Fine motor control requires a complex interaction of numerous muscles and other soft tissues throughout the entire upper extremity.

Despite the mechanical demands on the region, the soft tissues in the distal upper extremity are not designed to handle large or repetitive force loads. As a result, soft-tissue orthopedic disorders often result from repetitive overuse injuries in the distal upper extremity. The distal upper extremity includes more peripheral nerve compression pathologies than any other area of the body. The small size of the bones, muscles, tendons, and ligaments in the wrist and hand also make them vulnerable to high force loads, such as those which occur when falling on an outstretched hand. Because orthopedic disorders often involve soft-tissue overuse, massage is an excellent treatment strategy for addressing this problem.

INJURY CONDITIONS

LATERAL EPICONDYLITIS (TENNIS ELBOW)

Description

Upper-extremity cumulative trauma disorders are increasingly problematic in Western society and account for a great percentage of all occupational injuries.[1–3] Lateral epicondylitis is one of the most common of these upper-extremity overuse problems. The condition is known as tennis elbow because of the frequency with which it affects tennis players, but the overall percentage of individuals who develop this problem are not tennis players.

Lateral epicondylitis rarely involves inflammation of the epicondyle. Like other conditions called tendinitis, lateral epicondylitis involves collagen breakdown in the tendon fibers (tendinosis) and not an actual inflammatory problem.[4,5] In order to heal the condition there must be reduced tension on the damaged tendon fibers and some reduction in hypertonicity in the associated muscles.

The primary problem in lateral epicondylitis is with the common extensor tendons of the wrist and hand. The fibers of the extensor carpi radialis brevis (ECRB) appear to be affected most. This muscle has a relatively small attachment site on the lateral epicondyle, so the force generated by the muscle is concentrated in a small, localized area. However, any of the wrist extensors could be involved in this condition.

The tendon fibers from all the wrist extensor muscles come together near the attachment site at the lateral epicondyle. There is little distinction between the separate tendons where they attach at the epicondyle.[6] Because of its anatomical location certain activities put greater loads on the ECRB than on the other extensor tendons.[7]

The majority of problems in lateral epicondylitis result from excessive concentric wrist extension or eccentric wrist flexion. Either of these actions performed repetitively can overwhelm the tendon fibers and lead to tendon degeneration. Excessive or repetitive loads on the wrist extensor muscles occur in occupations in which the hands perform a repetitive task; grocery store clerks, computer workers, and carpenters are commonly afflicted with this condition.

Chronic tension in the wrist extensor muscles (isometric contractions) can also cause fatigue and tendon degeneration. Computer use is often a cause of upper-extremity overuse problems such as lateral epicondylitis.[8] When operating the mouse tension is held in the wrist extensor muscles, which pulls on the tendons. These conditions also develop due to other complex postural, psychological, and kinetic chain relationships, not simply too much keyboard or mouse activity.[9–12]

In addition to the more obvious movements of flexion and extension, there is evidence that repetitive supination and pronation of the forearm lead to epicondylitis. Overuse occurs when the flexor and extensor muscles engage strong isometric contractions to hold implements in the hand during these motions. The constant contractions of wrist muscles can also lead to the development of myofascial trigger points in the extensor muscles. These myofascial trigger points are likely to produce symptoms similar to the pain from tendon fiber degeneration, and can be a concurrent problem.[13]

Various approaches can be used to reduce fatigue on the forearm muscles during different activities. For example, forearm support bands are routinely advocated to decrease the collagen degeneration and tendon injury of epicondylitis. Whether or not these bands actually reduce epicondylitis is still to be determined.[14,15] One study found that wearing forearm support bands actually increased the rate of fatigue in unimpaired individuals, and can contribute to the problem more than solve it.[16]

Treatment

Traditional approaches

The primary goal in treating lateral epicondylitis is to repair the damaged collagen fibers in the tendon and restore the tendon to a healthy, functioning state. Tendon repair relies on reducing or eliminating as many of the stress factors as possible that led to the tendon damage. Rest from offending activities is necessary for this repair to succeed. Rest does not mean total inactivity, but simply a reduction in activities that aggravate the problem. Ice applications are used with some success.

Traditionally ice has been used as an anti-inflammatory treatment, but it is now understood that epicondylitis is usually not an inflammatory condition. Cold treatment is still effective for its other beneficial effects, such as pain management.

Rehabilitative exercise is used to heal the damaged tissue through revascularization and collagen repair.[5] The goal of rehabilitative exercise is to improve overall strength and endurance in the muscles of the entire kinetic chain that are involved in upper-extremity activities, including muscles of the neck, shoulder, arm, and elbow regions. However, attempting strength training activities with this muscle group while the tendon fibers are still damaged can further aggravate the problem. If the problem is not sufficiently advanced, strength training is beneficial. It can condition the tendons so they are more resistant to fatigue injury. Additional physical therapy modalities such as ultrasound, phonophoresis, or electrical stimulation are commonly used in treatment as well.[17]

The pain from lateral epicondylitis can be debilitating and interfere with an individual's ability to perform daily activities. Individuals may seek the short-term pain relief offered by anti-inflammatory medications (including corticosteroid injections). While there is usually some pain relief associated with these medications, their contribution to healing of the problem is questionable. In fact, their use can be detrimental to overall tendon healing.[18–20]

If the conservative measures of bracing, strength training, and relative rest are not effective at reducing the symptoms, surgical treatment may be performed. In surgical treatment the pathologic tissue is removed. The idea is that if damaged tissue is removed, healing in the remaining tissues will allow the region to become strong again. It is suggested that care be taken so that associated structures are not significantly weakened in the surgical treatment process.[21]

New techniques with arthroscopic procedures have helped minimize additional damaged tissue, and provide for more effective surgical treatment. Physicians are experimenting with laser treatment for lateral epicondylitis and finding some success with this process, although there is a need for further research.[22–24] Despite the wide number of treatments commonly used for lateral epicondylitis, many do not have an adequate physiological rationale to support their continued use.[25]

Soft-tissue manipulation

General guidelines As in traditional approaches, rest from offending activities is a crucial part of the healing process. There are several other factors that are essential for effective soft-tissue treatment of lateral epicondylitis. Because a primary problem in this condition is excessive hypertonicity in the muscles that attach at the lateral epicondyle, reducing muscular hypertonicity is a primary goal. Massage treatment begins with compressive effleurage and general sweeping cross fiber movements to reduce tension and enhance tissue mobility. After initial muscle relaxation work, deep broadening and lengthening techniques are used on the wrist extensor muscles. Broadening techniques enhance the ability of the fibers to spread and broaden as they go into concentric contraction. Lengthening techniques enhance tissue pliability and the muscle's ability to elongate. Longitudinal stripping techniques are particularly helpful for identifying and neutralizing myofascial trigger points.

At later stages of the rehabilitation as the tendons become less sensitive, the effects of pressure and movement can be enhanced through active engagement techniques for the wrist extensors. As the rehabilitation progresses it may be beneficial to use resistance, such as rubber tubing or elastic resistance band, for recruitment of additional muscle effort.

In addition to reducing muscle tension in the wrist extensors, massage treatment addresses the primary tissue problem, which is collagen degeneration in the tendon fibers. Collagen degeneration is treated with deep friction massage, which stimulates fibroblast proliferation to help heal the damaged tendon.[26,27] Stretching of the extensor tendons is also valuable during and after soft-tissue treatment. Stretching is something the client should continue at home on a regular basis.

Suggested techniques and methods

A. Sweeping cross fiber to wrist extensors Sweeping cross fiber is helpful for reducing overall tension in the wrist extensor muscles. It can be performed in conjunction with effleurage during initial treatment of this region. Use one hand to hold the client's wrist and the other hand to perform

Figure 12.1 Sweeping cross fiber to wrist extensors.

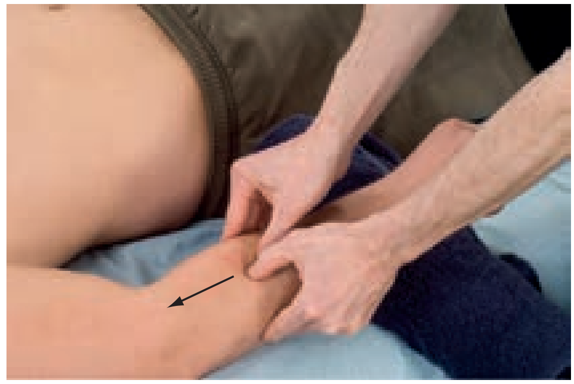

Figure 12.3 Deep stripping to extensor group.

a sweeping cross fiber technique to the wrist extensors (Fig. 12.1). Work the entire length of the forearm from the wrist to the elbow.

B. Compression broadening to wrist extensors After initial effleurage and cross fiber work, the extensor muscles can be treated at a deeper level with deep broadening techniques. The client is in a supine position with the forearm supported by the table. Perform deep compression broadening on the wrist extensor muscle group using the thenar eminence of the hand (Fig. 12.2). This is a cross fiber stroke so you can move from proximal to distal or vice versa.

C. Deep longitudinal stripping to wrist extensors Apply deep longitudinal stripping to wrist extensors to reduce tension and encouraging tissue pliability and flexibility. The client is supine on the treatment table. Use the fingers or thumb to perform a deep longitudinal stripping technique on the wrist extensors that begins at the wrist and continues to the extensor attachment site at the lateral epicondyle (Fig. 12.3). Continue the technique in successive strips until the entire muscle group has been treated.

D. Active engagement shortening techniques At the later stages of rehabilitation the intensity of pressure can be increased with active engagement techniques. The client is supine with a towel, bolster, or other support under the wrist so full wrist flexion and extension is possible. If a wrist support is not available, this technique can be performed with the client's hand off the edge of the table. Instruct the client to move the wrist through full flexion and extension at a moderately slow pace. Perform a compression-broadening stroke during wrist extension (Fig. 12.4). Gradually work

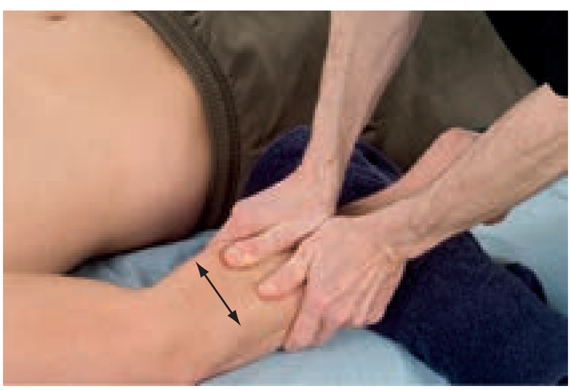

Figure 12.2 Compression broadening on wrist extensors.

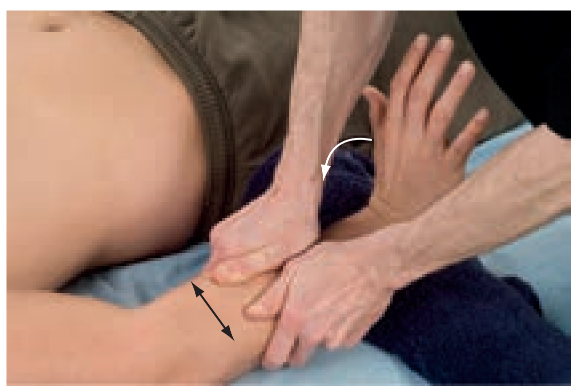

Figure 12.4 Active engagement shortening to wrist extensors.

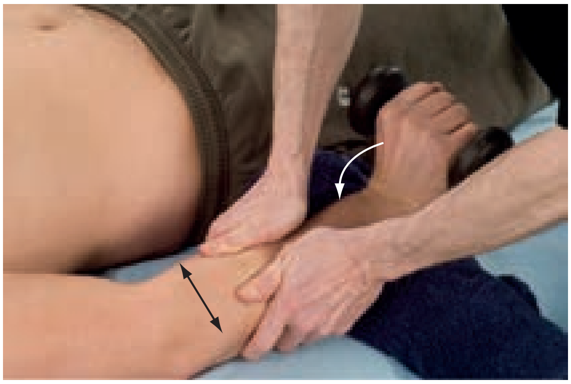

Figure 12.5 Active engagement shortening to wrist extensors with additional resistance of hand-held weight.

Figure 12.7 Active engagement lengthening of wrist extensors with manual resistance.

the entire length of the wrist extensor group, performing the stroke on each wrist extension. To increase the muscle recruitment and effectiveness of this technique, hand held weights or resistance bands can be used during the wrist extension (Fig. 12.5).

E. Active engagement lengthening techniques Even greater pliability and flexibility enhancement results from active engagement lengthening techniques. The client is in the same position as D above using either a support under the wrist or the hand dropped off the side of the table. Instruct the client to move the wrist through full flexion and extension at a moderately slow pace. Perform a deep longitudinal stripping technique in a distal to proximal direction during each eccentric wrist flexion movement (Fig. 12.6). Each stripping technique covers about 3–4 inches. Pause during the wrist extension and apply another stripping technique from where the last one stopped during the next wrist flexion movement. Continue this series of stripping motions during movement until the entire muscle has been adequately covered. Hand-held weights, resistance bands or manual resistance can be used to enhance the effectiveness of this technique (Fig. 12.7).

F. Deep friction to common extensor tendons The primary function of friction techniques is to stimulate fibroblast proliferation to enhance collagen repair in the damaged tendon. The wrist is in a flexed position because keeping the tendon on stretch helps the effectiveness of this technique. Use the fingertips or thumb to perform the deep friction technique to the common wrist extensor tendons (Fig. 12.8). The deep friction technique can be performed on the tendon transversely or longitudinally.

Figure 12.6 Active engagement lengthening of wrist extensors.

Figure 12.8 Deep friction on extensor tendons.

Rehabilitation protocol considerations

- Use appropriate assessment strategies to determine the severity of the condition. If the condition is severe, hold off on the more intense techniques such as the active engagement methods until later stages of the rehabilitation process.
- Cryotherapy is sometimes used both before and after the friction treatments to reduce discomfort.
- Stretching methods for the wrist extensors are an essential aspect of treatment. Stretching can be incorporated in the clinical session as well as by the client at home.
- Tendinosis is a slow-healing condition so encourage the client to be patient and consistent in efforts at home and in the clinic to assist in treatment.

Cautions and contraindications Symptoms of lateral epicondylitis may be confused with those from other problems and need to be accurately clarified before initiating treatment. Compression neuropathies of the radial nerve can produce pain sensations in the same region as lateral epicondylitis. Vigorous pressure techniques such as deep friction massage could aggravate the radial nerve compression. Accurate orthopedic assessment can help clarify the condition to assure a nerve pathology is not being aggravated.

MEDIAL EPICONDYLITIS (GOLFER'S ELBOW)

Description

Just like the extensor tendons in lateral epicondylitis, the flexor tendons are susceptible to overuse pain and dysfunction at their attachment site on the medial epicondyle of the humerus. The overuse can affect any of the flexor tendons, but the flexor carpi radialis is more susceptible to damage than the others.[28]

This condition is commonly called golfer's elbow because of the frequency with which it affects those playing golf. The problem occurs from swinging the golf club and then hitting the ball at the low point of the swing. The wrist flexors are engaged in a concentric contraction to swing the club toward the ground, and then when the ball is hit there is a sudden eccentric load on the flexor group. The eccentric loading forces are exaggerated because of the golf club's length.

Medial epicondylitis, like lateral epicondylitis, rarely involves an inflammatory reaction in the tissues. Collagen degeneration in the tendon fibers from chronic tensile loads is the primary dysfunction. Medial epicondylitis develops from repetitive concentric contractions of the wrist flexor group (producing wrist flexion) or eccentric activity of these muscles as the wrist is moving in extension. This problem can arise from repetitive supination and pronation of the forearm as well.

Box 12.1 Clinical Tip

Epicondylitis is a common disorder affecting the lateral elbow region. However, because lateral epicondylitis is so common, pain in this region is sometimes mistakenly attributed to overuse of the extensor tendons when they are not the tissue at fault. A branch of the radial nerve called the posterior interosseous nerve (PIN) courses under the supinator muscle near the lateral epicondyle of the humerus. Compression of the PIN in this region, also called radial tunnel syndrome, can produce lateral elbow pain very similar to that experienced in epicondylitis. Traditional treatment for epicondylitis is usually ineffective and the condition can linger for long periods. Hence, the condition has become known as "resistant tennis elbow."

In addition to elbow pain, compression of the PIN is likely to produce weakness of all the wrist extensor muscles. Epicondylitis is more likely to be painful on resisted wrist extension while radial tunnel syndrome is more likely to indicate weakness with little increase in pain. Massage treatment for epicondylitis involves deep friction on the proximal extensor tendons. However, that treatment could exacerbate a radial tunnel syndrome so it is important to make a distinction between these different conditions so proper treatment can be devised.

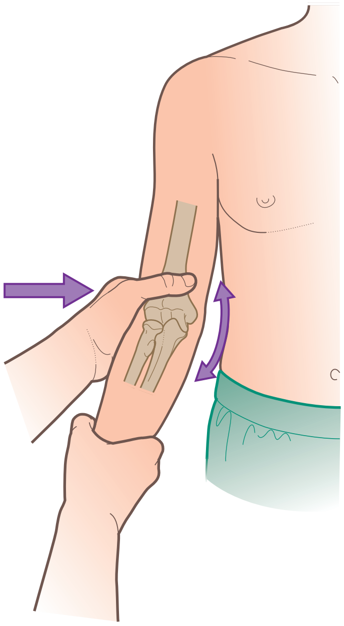

Figure 12.9 A valgus force applied to the elbow puts tensile stress on the flexor tendons.

Long periods of isometric contraction can also lead to tensile loads on the tendon fibers that cause collagen breakdown. This is especially true in occupations where the person has to grasp or hold tools or equipment in the performance of a specific job. For example, firmly holding a hammer requires strong contraction in the flexor muscles just to hold the hammer and swing it through space. Maintaining that grip when the hammer strikes a solid object is an additional load on the tendons that can lead to tendon degeneration when performed repetitively.

Medial epicondylitis also occurs from repeated throwing motions. There is a valgus force on the elbow during the throwing motion, and this force stresses the flexor tendons.[29] An illustration of valgus force on the elbow is shown in Figure 12.9. The strong valgus force on the elbow exaggerates stress on the tendons near their attachment site at the medial epicondyle.

Treatment

Traditional approaches

Conservative treatment for medial epicondylitis follows the same principles outlined above for lateral epicondylitis. A critical factor is to reduce or eliminate activities that are causing constant or repetitive tensile loads on the tendon fibers. In most instances, conservative measures, including elbow braces, stretching, ice applications, or flexibility enhancement, are effective in treating medial epicondylitis.

Anti-inflammatory medications, whether administered orally or through corticosteroid injection, are still used to treat this condition. However, treatment with anti-inflammatory medication is questionable because the problem is not generally an inflammatory condition.[30,31] There may be short-term benefits of pain reduction with corticosteroids, but their continued use is related to long-term connective tissues damage and tendon failure.[32,33]

In some instances, conservative methods are not effective and surgery is used for treatment. Surgical treatment is similar to that used for lateral epicondylitis. Any damaged tissue will be excised and the individual is encouraged to gradually return to prior activity levels. Physical therapy and strength training during the rehabilitative phase is important to gain strength in the tissues that have been weakened by the surgical fiber disruption.

Soft-tissue manipulation

General guidelines Soft-tissue treatment of medial epicondylitis uses the same general guidelines as treatment for lateral epicondylitis described above. The difference is that in this case attention is focused on the wrist flexors instead of the extensors. Rest from offending activities and reduction of hypertonicity in the flexor muscles are essential components of the rehabilitation process. Massage treatment begins with compressive effleurage and general sweeping cross fiber movements. Deep compression broadening to the wrist flexor muscles helps reduce hypertonicity, enhance pliability, and decrease the tensile load on the flexor tendons. In addition, deep longitudinal stripping and some of its variations are used to help encourage elongation and elasticity in the flexor muscles. These techniques are also effective for identifying and treating myofascial trigger points.

At later stages of the rehabilitation when the tendons become less sensitive, shortening and lengthening active engagement techniques are used to enhance the effects of pressure and movement. These techniques may be used earlier in the treatment program if the condition is not severe. They are also valuable as a preventive strategy when trying to keep the forearm's soft tissues resilient and prevent overuse injury.

The primary tissue dysfunction (collagen degeneration of the flexor tendons) is effectively treated with deep friction massage. The purpose of deep friction massage treatment is to stimulate collagen production in the damaged tendon tissue. Stretching of the flexor tendons is also helpful during and after the soft-tissue treatment, and should be regularly performed by the client at home.

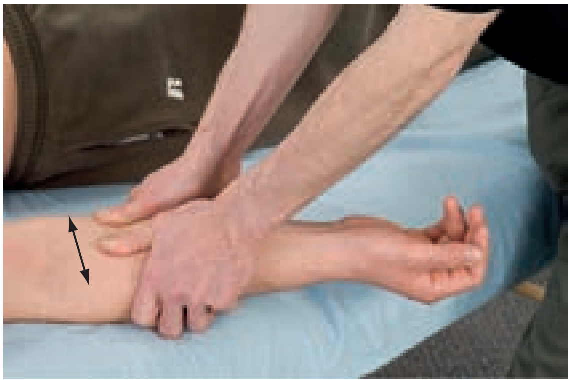

Figure 12.11 Compression broadening on wrist flexors.

Suggested techniques and methods

A. Sweeping cross fiber to wrist flexors This technique helps reduce tension in the wrist flexor group and prepare the muscles for deeper work. It is easily performed in conjunction with effleurage when first beginning treatment. Use one hand to hold the client's wrist and the other hand to perform a sweeping cross fiber technique to the wrist flexors (Fig. 12.10). Work the entire length of the forearm from the wrist to the elbow. Use caution with pressure applied in the sweeping thumb motion as you near the flexor attachments at the medial epicondyle. The ulnar nerve is somewhat superficial in this region and you can put adverse pressure on it.

B. Compression broadening to wrist flexors After initial effleurage and cross fiber work, the wrist flexor muscles are worked deeper in a cross fiber direction with deep broadening techniques. The client is supine with the forearm supported by the table. Perform deep compression-broadening strokes on the wrist flexor muscle group using the thenar eminence of the hand (Fig. 12.11). Each compression-broadening stroke is a cross fiber movement so it doesn't matter if they are moving progressively toward the elbow or toward the wrist.

C. Deep longitudinal stripping to wrist flexors Tissue elasticity is enhanced and muscle tension further reduced with deep stripping techniques. The client is supine on the treatment table. Use the fingers or thumb to perform a deep longitudinal stripping technique on the wrist flexors that begins at the wrist and continues to the flexor attachment site at the medial epicondyle (Fig. 12.12). This stroke is using deep specific pressure on the extremities, so follow the venous return with this stroke and move distal to proximal with each stripping motion. Continue the technique in successive strips until the entire muscle group has been treated.

Figure 12.10 Sweeping cross fiber to wrist flexors.

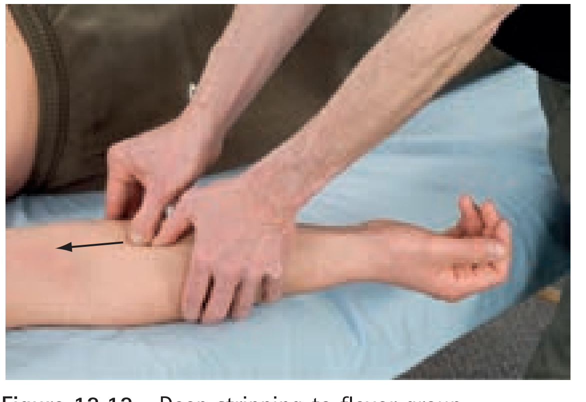

Figure 12.12 Deep stripping to flexor group.

D. Active engagement shortening techniques At the later stages of rehabilitation the intensity of pressure can be increased with active engagement techniques. The client is supine with a towel, bolster, or other support under the wrist so full wrist flexion and extension is possible. Just like for lateral epicondylitis if a wrist support is not available, the technique can be performed with the client's hand off the edge of the table. The client moves the wrist through full flexion and extension at a moderately slow pace while a compression-broadening stroke is applied to the wrist flexor muscle group (Fig. 12.13). Gradually work the entire length of the flexors, performing the stroke on each wrist flexion until the entire muscle has been treated. To increase the muscle recruitment and effectiveness of this technique, hand-held weights or resistance bands can be used during the wrist flexion in the same way it was pictured and described for lateral epicondylitis in Figure 12.5. The only difference is that the weight or resistance will be in wrist flexion instead of extension.

E. Active engagement lengthening techniques Active engagement lengthening achieves greater pliability and flexibility enhancement. The client is in the same position as D above using either a support under the wrist or the hand dropped off the side of the table. The client moves the wrist through full flexion and extension at a moderately slow pace. Perform a deep longitudinal stripping technique in a distal to proximal direction during each eccentric wrist extension movement

Figure 12.13 Active engagement shortening to wrist flexors.

Figure 12.14 Active engagement lengthening to wrist flexors.

(Fig. 12.14). Each stripping technique covers about 3–4 inches. Pause during the wrist flexion and apply another stripping technique from where the last one stopped during the next wrist extension movement. Continue this series of stripping motions until the entire muscle has been adequately covered. Hand-held weights, resistance bands or manual resistance can be used to enhance the effectiveness of this technique just like it was described for lateral epicondylitis in Figure 12.7. The only difference is that in this technique the increased resistance is with the flexor group instead of the extensors.

F. Deep friction to common flexor tendons Friction techniques stimulate fibroblast proliferation in the tendon and enhance collagen repair in order to heal the damaged tendon. However, this is a slow physiological process, so quick or immediate results from treatment should not be expected. The wrist is in an extended position because keeping the tendon on stretch helps the effectiveness of this technique. Use the fingertips or thumb to perform the deep friction technique to the common wrist flexor tendons, transversely or longitudinally (Fig. 12.15).

Rehabilitation protocol considerations

- See the rehabilitation protocol considerations for lateral epicondylitis, which are the same for medial epicondylitis except the focus is on the wrist flexors instead of the wrist extensors.

Cautions and contraindications

The ulnar nerve courses through the cubital tunnel near the medial epicondyle of the humerus (see the discussion of cubital tunnel syndrome below). Ulnar nerve

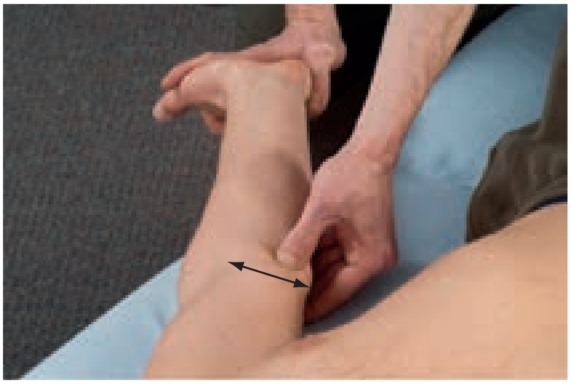

Figure 12.15 Deep friction on the common flexor tendons.

compression pathologies can produce symptoms similar to medial epicondylitis and sometimes be mistaken for this condition so proper assessment is important to distinguish these different pathologies. Use caution when performing friction techniques to the proximal flexor tendons as pressure can be accidentally applied to the nerve. The nerve is close to the skin surface in this region, so use care with cryotherapy approaches to make sure the cold application does not cause nerve damage.

CUBITAL TUNNEL SYNDROME

Description

The upper extremity is plagued by nerve compression pathologies where soft tissues compress the adjacent nerves. While carpal tunnel syndrome is a well-known, upper-extremity, nerve-compression pathology, cubital tunnel syndrome has received less attention, although it occurs with moderate frequency. The condition has been reported as the second most common peripheral compression neuropathy.[34]

The cubital tunnel is the space between two heads of the flexor carpi ulnaris muscle on the posterior side of the elbow. One head is derived from the common flexor tendon attachments at the medial epicondyle of the humerus. The other head originates on the medial aspect of the olecranon process. The two heads eventually join to form the prominent belly of the flexor carpi ulnaris. In the elbow region where the two heads are separated, the ulnar nerve travels between them and this region is the cubital tunnel (Fig. 12.16). In cubital tunnel

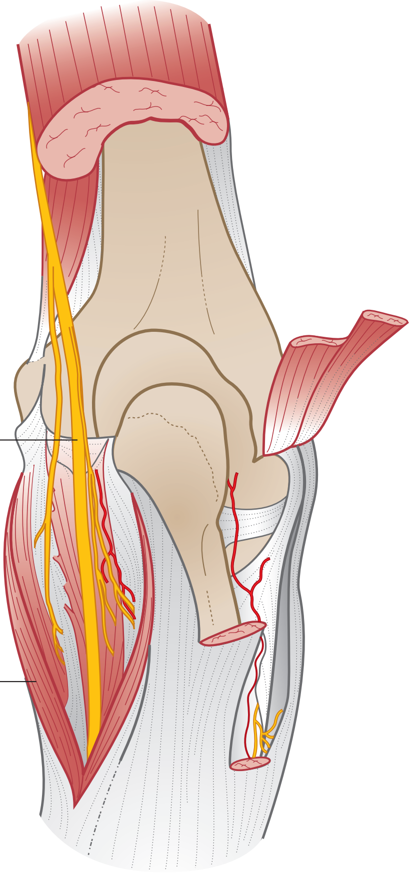

Figure 12.16 Posterior view of the right elbow showing the ulnar nerve entering the cubital tunnel between the two heads of the flexor carpi ulnaris.

syndrome the ulnar nerve is compressed by one or both heads of the flexor carpi ulnaris muscle.

Cubital tunnel syndrome can develop from several factors, including external forces such as leaning on the elbow for long periods, as well as repetitive motion, throwing, or prolonged elbow flexion.[35] Certain movements or positions can aggravate nerve compression in the cubital tunnel. During flexion of the elbow, the two heads of the flexor carpi ulnaris are pulled apart as the olecranon process moves slightly away from the humerus. As this occurs the tunnel becomes narrower and pressure increases on the ulnar nerve. Volume in the cubital tunnel can decrease by as much as 55% during elbow flexion.[34]

Symptoms of cubital tunnel syndrome include pain, paresthesia, or numbness in the ulnar aspect of the hand. Problems with muscle weakness in the hand can also occur because the ulnar nerve innervates a number of muscles in the hand. Atrophy or muscle wasting may be apparent on the thenar eminence of the hand from impaired nerve function. Ulnar nerve motor dysfunction causes an inability to grip and hold objects between the thumb and fingers. The adductor pollicis muscle, innervated by the ulnar nerve, is necessary for this pinch grip action of the thumb. These indicators of motor dysfunction help identify cubital tunnel syndrome. In some upper-extremity nerve compression pathologies, such as carpal tunnel syndrome, there is a greater percentage of sensory symptoms. In cubital tunnel syndrome motor symptoms are more typical.[36]

Treatment

Traditional approaches

If this condition has occurred from external pressure, such as leaning on the elbows for prolonged periods, or a direct blow to the area, the most important factor for proper rehabilitation is removal of those external forces. Nerve damage from compression can take a long time to heal, depending on the amount of compression applied and for how long (see the discussion in Chapter 2 on nerve compression injuries). In some cases a splint may be used to immobilize the elbow and wrist to keep from further aggravation of the nerve.[37] Elbow flexion at night can aggravate the problem because of increased neural compression in the cubital tunnel. Splinting the elbow at night to prevent flexion can be a valuable part of treatment.[38]

If conservative treatment is not successful, there are several surgical procedures that may be used to treat cubital tunnel syndrome. One of the most frequently used procedures is called an anterior transposition. In this procedure the ulnar nerve is repositioned so it is not compressed in the cubital tunnel. Other procedures include removing a portion of the medial epicondyle and slicing the aponeurosis that covers the tunnel to make more room for the nerve.[39]

Soft-tissue manipulation

General guidelines Massage for cubital tunnel syndrome focuses on relieving ulnar nerve pressure by the soft tissues. The flexor carpi ulnaris is the primary problem so attention focuses on techniques designed to reduce tension in the wrist flexor group. Stretching (mobilizing) the ulnar nerve is a valuable aspect of treatment because lack of neural mobility can be a causative factor in the condition.[40]

Massage treatment should emphasize treating soft tissues throughout the entire length of the ulnar nerve in the upper extremity. A double or multiple crush nerve dysfunction could exist, so freeing the ulnar nerve along its entire path is important (see the discussion in Chapter 2 on the double or multiple nerve crush phenomenon). When addressing neural compression and tension pathologies, assume there may be more than one site of irritation. All potential sites of ulnar nerve entrapment should be addressed to give the nerve tissue the greatest chance for healthy biomechanics and function. Additional areas to focus soft-tissue treatment include the region between the anterior and middle scalene muscles, under the clavicle and pectoralis minor muscle, near the elbow, and in the wrist at the Guyon's canal.

Suggested techniques and methods

A. Sweeping cross fiber to wrist flexors Sweeping cross fiber to wrist flexors reduces tension in the wrist flexor group. Muscle tension can contribute to neural compression or restriction. Use one hand to hold the client's wrist and the other hand to perform a sweeping cross fiber technique to the wrist flexors (Fig. 12.10). Work the entire length of the forearm from the wrist to the elbow. Use caution with the amount of pressure in the sweeping thumb motion near the flexor attachments at the medial epicondyle. This is the region where the ulnar nerve is likely being compressed in the cubital tunnel.

B. Deep longitudinal stripping to flexor carpi ulnaris Tissue elasticity is enhanced and muscle tension reduced in the flexor carpi ulnaris with deep stripping techniques. Use the fingers or thumb to perform a deep longitudinal stripping technique on the flexor carpi ulnaris and other wrist flexors (Fig. 12.12). This stroke uses deep specific pressure on the extremities, so follow the venous return with this stroke and move distal to proximal with each stripping motion. Continue the technique in successive strips until the entire area has been treated. Use caution with pressure near the cubital tunnel so nerve compression is not aggravated.

C. Active engagement shortening techniques Muscle tension in the flexor carpi ulnaris can be further reduced with active engagement techniques. The client is supine with a towel, bolster, or other support under the wrist so full wrist flexion and extension is possible. If a wrist support is not available, the technique can be performed with the client's hand off the edge of the table. The client moves the wrist through full flexion and extension at a moderately slow pace. Perform a compression broadening technique to the wrist flexor muscle group during each wrist flexion movement (Fig. 12.13). Gradually work the entire length of the flexors, performing compression broadening during each wrist flexion.

D. Active engagement lengthening techniques Active engagement lengthening helps achieve greater pliability and flexibility enhancement. It can also encourage greater neural mobility. The client is in the same position as C above using either a support under the wrist or the hand dropped off the side of the table. The client moves the wrist through full flexion and extension at a moderately slow pace. Perform a deep longitudinal stripping technique in a distal to proximal direction during each eccentric wrist extension movement (Fig. 12.14). Each stripping technique covers about 3–4 inches. Pause during the wrist flexion and apply another stripping technique from where the last one stopped during the next wrist extension movement. Address all wrist flexors, but pay particular attention to the flexor carpi ulnaris.

E. Ulnar neural mobility If soft-tissue adhesion is binding the ulnar nerve in the cubital tunnel, neural mobility techniques help mobilize the nerve and free the adhesions restricting it. Ulnar neural mobility techniques can be performed in any position and the client can use these techniques on their own at home. Begin with the arm at the side with the elbow extended and the wrist in a neutral position. Slowly bring the extremity into a position of elbow flexion, full wrist extension and shoulder abduction to stretch the nerve and enhance mobility (Fig. 12.17). Bring the extremity only to the point where symptoms are first felt. Once that point is reached, bring the arm back into a slackened position for the nerve (toward the original starting position). Again, take the arm to the fully stretched position, stop when symptoms are felt, and return it to a neutral position. This cycle of neural stretch and relaxation is repeated a number of times to encourage mobility of the ulnar nerve in the cubital tunnel region. However, if neural symptoms are increased with the movements, do not continue the process.

Figure 12.17 Neural stretching for ulnar nerve.

Rehabilitation protocol consideration

- Nerves damaged by compression are slow to heal. Cubital tunnel syndrome is a chronic condition, so do not expect immediate results with treatment.
- Initial treatment should focus on reducing tension in the flexor carpi ulnaris muscle. Depending on the severity of the condition, symptoms may be too strong to initiate neural stretching procedures until later stages of rehabilitation.
- Stretching for the wrist flexor muscles should be incorporated along with soft-tissue treatment. Stretching should be encouraged at home as well.
- Some individuals find benefit with elbow braces that prevent full elbow flexion at night while asleep. This can help decrease overall compression on the ulnar nerve.

Cautions and contraindications Use caution with massage techniques performed in this region where pressure is applied near the cubital tunnel. Additional pressure to nerve compression pathology is counterproductive and can exacerbate the condition. The space within the tunnel is reduced during elbow flexion, so be cautious with pressure applied in the cubital tunnel region when the elbow is flexed. Some people advocate ice applications to address pain sensations. However, the ulnar nerve is superficial and close to the skin in this region and thus vulnerable to nerve damage from cold applications so caution is advised.

PRONATOR TERES SYNDROME

Description

Pronator teres syndrome (PTS) is a median nerve compression pathology frequently mistaken for carpal tunnel syndrome. Carpal tunnel syndrome is a widely known nerve compression pathology. As a result, some health care providers are quick to diagnose the condition without fully exploring other possibilities. PTS produces similar symptoms and some suggest that pronator teres entrapment is under-diagnosed. This is one of the reasons for a high percentage of failed carpal tunnel syndrome surgeries.[41,42]

In PTS the pronator teres muscle is compressing the median nerve near the elbow. There are two separate heads of the pronator teres muscle (Fig. 12.18). The median nerve passes between the two heads of the pronator teres muscle and this is where compression occurs. Several factors can be responsible for median nerve compression in PTS. These factors include hypertonicity of the pronator teres muscle, fibrous bands within the muscle, and anatomical anomalies of the muscle. A tight pronator teres that compresses the median nerve results from repetitive motions of the elbow in flexion and/or forearm in pronation. Repetitive motions in numerous occupations, for example construction or assembly line work, create sufficient tension in the pronator teres muscle to produce nerve compression;

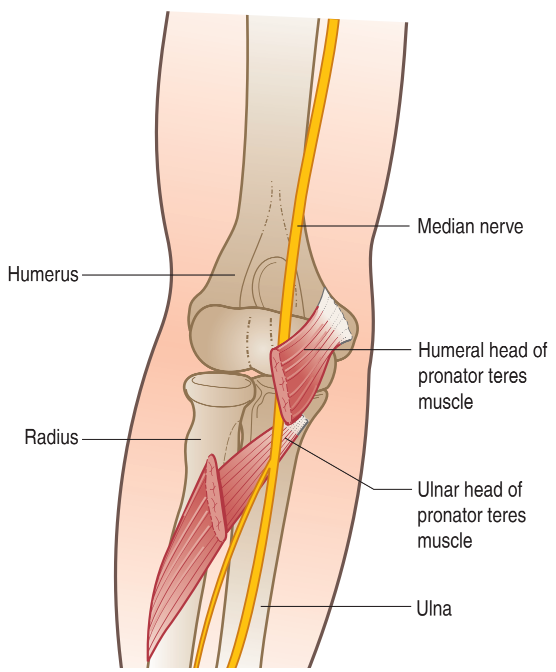

Figure 12.18 Anterior view of the right elbow showing the median nerve coursing between the two heads of the pronator teres.

Muscles can also have strong fibrous bands throughout their length. These fibrous bands are tough and can compress more delicate structures like a nerve. Surgical dissections have identified fibrous bands in the pronator teres muscle and suggest these bands are frequent contributors to median nerve compression.[43]

Certain anatomical anomalies also contribute to nerve compression in PTS. In some cases, the median nerve runs deep to both heads of the pronator teres muscle. In this case, the pronator teres can compress the median nerve against the ulna. Other anatomical anomalies include nerve compression resulting from a median nerve running directly though one of the two heads of the pronator teres.[44]

Clients with pronator teres syndrome are most likely to describe mild or moderate aching in the forearm. There may also be descriptions of sharp, shooting, pains into the hand along the sensory distribution of the median nerve. Paresthesia may be present, but the paresthesia is not often as clearly limited to the hand as with carpal tunnel syndrome. Repetitive motions that involve the elbow can also aggravate the condition.

Unlike clients with carpal tunnel syndrome who may experience night pain those with pronator teres syndrome usually do not. Prolonged wrist flexion during sleep aggravates carpal tunnel syndrome because that position compresses the median nerve in the carpal tunnel. Wrist flexion does not affect the pronator teres muscle, so nerve compression by the pronator teres is not increased at night.

Another cause of median nerve compression near the pronator teres is a fibrous band from the biceps brachii muscle. This fibrous band connects the distal portion of the biceps brachii to the forearm. The fibrous band is called the lacertus fibrosus. The median nerve passes underneath the lacertus fibrosus, and can be compressed by it, especially during repetitive strong contractions of the biceps brachii. Median nerve compression by the lacertus fibrosus is easily mistaken for pronator teres syndrome, though it is treated in a similar way to PTS with more focus on the biceps brachii muscle group.

Treatment

Traditional approaches

As with all nerve compression pathologies, the primary focus of treatment is to reduce offending activities that aggravate the problem. It may not be possible to completely eliminate these activities, but they should be decreased. Splints or braces are sometimes used to alter biomechanical patterns that contribute to the problem. If conservative treatment of PTS is not successful, surgery is sometimes used. Surgical procedures focus on releasing constricting tissues such as fibrous bands within the muscle or a portion of the pronator teres muscle.[45] While surgery may be successful in relieving symptoms in some cases, it is not clear that there is a need for surgery in most cases.[36]

Soft-tissue manipulation

General guidelines The pronator teres muscle is synergistic with the wrist flexor muscles. Consequently, treatment of the wrist flexors is an important first step in addressing pronator teres dysfunction. Following general treatment of the flexor muscles in the forearm, address the pronator teres with more specific treatment. Hypertonicity of the pronator teres is a primary aspect of this condition, so techniques that are specifically designed to reduce tension in the pronator teres are particularly valuable. Specific treatment is applied through deep stripping, active engagement, as well as pin and stretch techniques.

As with other nerve compression and tension neuropathies, it is important to address additional regions along the nerve's pathway where mobility restrictions can occur. Lack of neural mobility in these regions can sensitize the median nerve and make it more prone to aggravation by pronator teres entrapment. Additional locations of entrapment include the region between the anterior and middle scalene muscles, underneath the clavicle, underneath the pectoralis minor muscle, along the anterior aspect of the elbow, and in the wrist at the carpal tunnel. Neural stretching techniques are used to improve mobility of the median nerve as it passes through these various regions. Perform the neural stretching procedures after other soft-tissue manipulation strategies for the flexors and pronator teres. Reduced tension in these other soft-tissues enhances neural mobility.

Suggested techniques and methods

A. Deep stripping to wrist flexor group General massage applications are performed on the wrist flexor group prior to deep stripping techniques. After general applications decrease tension, more specific treatment is used on the proximal end of the wrist flexors near the pronator teres attachment. The client is supine on the treatment table. Use the fingers or thumb to perform a deep longitudinal stripping technique on the wrist flexors that begins at the wrist and continues to the flexor attachment site at the medial epicondyle (Fig. 12.12). This stroke uses deep specific pressure on the extremities, so follow the venous return with this stroke and move distal to proximal with each stripping motion. Continue the technique in successive strips until the entire muscle group has been treated.

B. Compression broadening for wrist flexors The client is supine with the forearm supported by the table. Perform compression broadening strokes on the wrist flexor muscle group using the thenar eminence of the hand (Fig. 12.11). Each compression broadening stroke is a cross fiber movement so it does not matter if the stroke moves progressively toward the elbow or toward the wrist. This technique works toward reducing tension and enhancing pliability in the wrist flexor muscles as they can contribute to developed tension in the pronator teres.

C. Active engagement lengthening to wrist flexors The client is in the same position as B above using either a support under the wrist or the hand dropped off the side of the table. The client moves the wrist through full flexion and extension at a moderately slow pace. Perform a deep longitudinal stripping technique in a distal to proximal direction during each eccentric wrist extension movement (Fig. 12.14). Each stripping technique covers about 3–4 inches. Pause during the wrist flexion. Then during the next wrist extension movement apply another stripping technique from where the last stroke stopped. Continue this series of stripping motions during movement until the entire muscle has been adequately covered. Hand-held weights, resistance bands, or manual resistance can be used to enhance the effectiveness of this technique.

D. Pin and stretch for pronator teres The pronator teres is a difficult muscle to isolate for stretching or massage treatment. The pin and stretch technique is a great way to apply more specific treatment to the pronator teres and reduce adverse compression of the median nerve. The client is in a supine position with the elbow partially flexed. Grasp the client's hand as if in a handshake position. While holding the client's hand in the handshake position, fully pronate the client's forearm, thus shortening the pronator teres muscle. Apply pressure to the pronator teres muscle with the thumb of the opposite hand (Fig. 12.19). The pronator teres can be located by first finding the gap on the anterior elbow region between the forearm flexors and extensors. Place the thumb in the gap between those two muscle groups. When the thumb is pushed medially the pronator teres is the first muscle encountered. Maintain pressure on the pronator teres while supinating the client's forearm with the hand that is holding the client's hand. The thumb of one hand performs the pin while the thumb of the other hand performs the stretch.

E. Active engagement lengthening for pronator teres The client and practitioner are in the same starting position as in C above with one hand grasping the client's hand in the handshake position and the other thumb applying pressure to the pronator teres muscle. With the pronator teres in the shortened position, instruct the client to hold that position while attempting to supinate the client's wrist. Once an isometric contraction is established, instruct the client to slowly release the contraction. As the client slowly lets go, the client's hand turns so the forearm moves in supination. As the forearm is supinated, perform a stripping technique directly on the pronator teres muscle (Fig. 12.20).

Rehabilitation protocol considerations

- As with other nerve compression pathologies, nerve damage is slow to heal. Immediate or rapid results can occur but resolution of the condition is more likely to be a slow and gradual process.
- The symptoms of pronator teres syndrome and carpal tunnel syndrome can be identical and it can be difficult to isolate exactly where the nerve compression is occurring. In the event of apparent distal median nerve pathology it is advantageous to treat for both pronator teres and carpal tunnel syndromes as long as the symptoms are not aggravated.

Figure 12.19 Pin and stretch for pronator teres.

Figure 12.20 Active engagement lengthening for pronator teres.

- If the condition is severe, treatments such as the pin and stretch or active engagement lengthening for pronator teres may be too intense for the client. Reserve these techniques for later stages of the rehabilitation process or for conditions that are not severe to begin with.
- Stretching for the wrist flexor muscles should be incorporated along with soft-tissue treatment. Stretching should be encouraged at home as well.
- If symptoms are severe and soft-tissue treatment aggravates neurological sensations, decrease the pressure level and duration of treatment until a tolerable level is found for the client.

Cautions and contraindications Use caution when performing techniques directly on the pronator teres muscle because pressure might be applied very close to the region of nerve entrapment. If the client reports additional symptoms of nerve compression during the technique release pressure in that region and move to another location on the muscle that does not further compress the nerve. Pressure on hypertonic muscles can be uncomfortable and increase pain or discomfort, but is still beneficial treatment. However, additional pressure on a site of nerve compression is not helpful and should be avoided. If pressure increases radiating neurological sensations it is likely that the treatment is putting pressure on a nerve and that pressure must be ceased.

CARPAL TUNNEL SYNDROME

Description

Carpal tunnel syndrome (CTS) is the most well-defined and frequently studied upper-extremity entrapment neuropathy. As a result there is a good understanding of the various causes of this problem. Yet, because CTS has become so widely known, there is a tendency to assume CTS is the cause of symptoms, which can lead to overlooking other upper-extremity neuropathies. CTS can occur alongside another compression condition in the hand involving the ulnar nerve in the Guyon's canal (see below).

The carpal tunnel is bounded by the carpal bones and the transverse carpal ligament (TCL) (also called the flexor retinaculum). The flexor retinaculum attaches to the pisiform and hamate on the medial side and then spans the tunnel to connect with the trapezium and scaphoid on the lateral side (Fig. 12.21). Nine flexor tendons and the median nerve course through the carpal tunnel. The tendons in the tunnel include the flexor pollicis longus, four flexor digitorum superficialis tendons, and four flexor digitorum profundus tendons. The median nerve is the most superficial structure of those in the tunnel and, therefore, very likely to be compressed against the TCL.[46]

The problem of carpal tunnel syndrome is usually an intrinsic pathology. That means the nerve compression occurs from factors within the tunnel as opposed to pressure or forces applied from

Box 12.2 Clinical Tip

Median nerve entrapment, especially in the carpal tunnel, is one of the most common upper-extremity injuries. While the carpal tunnel is the likely site for median nerve entrapment, there are at least half a dozen potential sites of nerve entrapment between the neck and hand. In many cases, a carpal tunnel syndrome becomes more symptomatic than it normally would because there is at least one additional location of nerve compromise along the median nerve's path. Even a partial nerve entrapment can complicate the condition.

Traditional treatments for carpal tunnel syndrome often only focus attention on the carpal tunnel itself at the base of the hand. The contribution of nerve entrapments in other locations can be overlooked. An advantage of massage therapy treatment is the amount of time the practitioner spends with the client and the subsequent thoroughness of soft-tissue treatment that can be applied throughout the entire upper extremity. Extensive massage treatment along the entire path of the median nerve helps make sure any of these potential sites of nerve entrapment are properly neutralized.

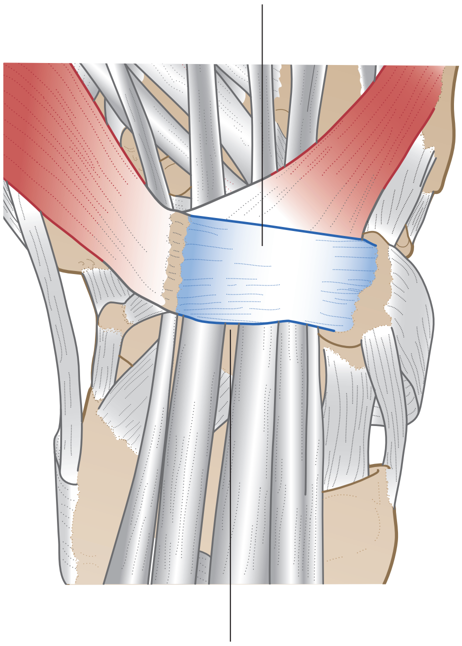

Figure 12.21 Anterior view of the left wrist showing the carpal tunnel.

outside the tunnel. One of the most common causes for tunnel compression is tenosynovitis in the flexor tendons that travel through the tunnel. The flexor tendons must bend during wrist flexion or extension. A synovial sheath encloses the tendons to reduce friction during these movements. As a result of overuse, adhesion or inflammation can develop between the tendons and their synovial sheath. This is tenosynovitis and it increases the size of the tendon sheaths due to the inflammatory reaction. The increased tendon sheath size takes up additional space in the tunnel causing compression of the median nerve.

Differences in the shape of the wrist play a role in decreasing space in the tunnel as well. Kuhlman and Hennessey present a ratio of measuring the width and height of the carpal tunnel to describe the interior shape of the tunnel.[47] Their work shows that variations in shape have a strong correlation with the likelihood for developing CTS. Cross-sections of the wrist vary in shape from square to oval. The closer a wrist cross-section was to square, the more likely the individual would be to develop CTS. This indicates that wrist shape can be a valuable factor in assessing the presence of CTS as well.

Electrodiagnostic studies are frequently used to verify carpal tunnel syndrome, but they are not a completely reliable source of information.[48–51] In some instances, electrodiagnostic studies were not found to give any greater degree of accuracy in identifying this problem than good clinical evaluation procedures.[52] Yet, reliance on clinical tests alone also appears to lack precision, as there are significant concerns with the accuracy of commonly used clinical evaluation tests.[47,52]

Women have a greater reported incidence of CTS than men. However, it is unclear if there is a gender specific factor or if the higher occurrence is a result of greater representation of women in statistical evaluations. There are also more women in jobs that are at high risk for CTS.[53,54] These occupations generally include repetitive hand tasks, such as data entry, factory, packaging, janitorial, and cleaning jobs.

There are other factors that can lead to intrinsic compression of the median nerve in the tunnel such as fluid retention during pregnancy. Small tumors or ganglions that develop in the tunnel can also take up space. These tumor-like structures may not be painful themselves, but cause additional pressure on other structures in the tunnel such as the median nerve. An acute injury that dislocates or fractures hand bones can also create a CTS. Diabetes, arthritis, hypothyroidism, smoking, obesity, and caffeine intake have all been associated as greater risk factors for CTS.

The first and most common symptoms to appear in CTS are usually the sensory symptoms of paresthesia, numbness, and pain in the median nerve distribution of the hand. The symptoms are more often sensory than motor in CTS because the median nerve at the wrist is composed of over 90% sensory fibers and less than 10% motor fibers.[55] Symptoms are often worse at night because people bend their wrists in flexion while sleeping, and this wrist position increases compression within the tunnel. Wrist splints worn at night that keep the wrist in a neutral position can alleviate this irritation while sleeping.

If motor symptoms are present, it is usually an indication of a greater degree of pathology and nerve compression. As the condition progresses there can be a decrease in tactile sensitivity in the fingertips. Motor symptoms develop in more serious conditions and are indicated by clumsiness, loss of dexterity, and eventually a weakening of grip strength in the hand. If the condition progresses, there is a decrease in two-point discrimination ability, further sensory loss, and wasting of the muscles in the thenar aspect of the hand.

Treatment

Traditional approaches

Because CTS cases typically involve work settings, rehabilitative strategies generally focus on workplace ergonomics in an effort to reduce the aggravating occupational factors. Ergonomic interventions include wrist braces and supports, newly designed equipment, altered work schedules to mix activities, and tool redesign. There are benefits to these approaches, but no single solution is a reliable prevention strategy for work-related CTS.[56]

As with other neuropathies, reduction of offending activities is an essential aspect of the rehabilitative process. Other treatment strategies include corticosteroid injections, oral steroids, and various non-steroidal anti-inflammatory drugs. Diuretics may also be used if pressure has increased within the tunnel from fluid retention. Wrist splints are advocated, especially at night. Night splints are helpful because they do not interfere with daily activities and relief of nerve compression at night may be sufficient to adequately facilitate the healing process.

When conservative measures are unsuccessful, CTS is often treated with surgery. The primary surgical technique used to treat CTS is the release of the TCL. This procedure is performed by making an incision in the TCL in order to reduce compression of the tunnel's contents against the ligament. While this procedure can be successful, unsuccessful CTS surgery is not uncommon.[36] Because surgical outcomes for CTS are uncertain, it is valuable to fully exhaust conservative methods, such as massage, before resorting to surgical treatment.

Soft-tissue manipulation

General guidelines A primary part of the problem in CTS includes hypertonicity and overuse in the flexors of the wrist and hand, so CTS treatment initially focuses on these muscles. Treatment begins with general treatment on the wrist flexor muscles and then proceeds to more specific approaches on the muscles and the region around the carpal tunnel itself. Use caution not to apply adverse pressure to the median nerve, especially near the carpal tunnel. Some techniques, such as the active engagement methods are more intense for the client, and should be reserved for later stages of rehabilitation.

In addition to reducing tension on the wrist flexor muscles, a primary goal of treatment is to decrease direct pressure on the median nerve at the carpal tunnel region. While ligaments such as those that span the carpal tunnel are generally not very pliable, certain myofascial techniques have demonstrated the ability to slightly increase length in the TCL. This technique appears to be most effective when the condition is not severe.[57] There is still question about the physiology of this procedure as there are conflicting reports of how extensible and pliable the TCL actually is. Even if it is not very pliable, this technique still appears beneficial in reducing symptoms.[58]

Stretching of muscles in the forearm, especially the wrist flexors is valuable to reduce hypertonicity and overuse irritation. In addition, treat muscles and soft tissues throughout the entire upper-extremity kinetic chain, as tension in these muscles contribute to biomechanical dysfunction that eventually becomes symptomatic in the carpal tunnel.[59] In the later stages of rehabilitation neural mobilization procedures for the median nerve can also be helpful.

Suggested techniques and methods Initial treatment of CTS focuses on the wrist flexor muscles, just as with PTS. Treatment can begin by using techniques A, B, and C listed in the previous section on PTS.

Figure 12.22 Myofascial release of transverse carpal ligament.

Figure 12.23 Stretching the wrist flexors and transverse carpal ligament.

A. Myofascial release of carpal tunnel This myofascial technique is used to increase length in the TCL so there is a reduction of pressure on the median nerve. The client is in a supine position with the forearm supinated so the palm is facing up. Grasp the client's hand and apply pressure in opposite directions across the base of the client's hand with the thumbs to the attachments of the TCL (Fig. 12.22). Hold this stretch position for about 20–30 seconds to enhance elongation of the TCL and flexor tendons. This technique should not increase neurological symptoms so do not continue pressure if it does. However, a short duration of symptom increase during pressure on this region should not cause adverse effects.

B. Stretching wrist flexors and transverse carpal ligament Tissue elongation for the flexor muscles and TCL is also enhanced with this myofascial procedure. Begin the technique with the client's hand in a supinated position. Pull the client's wrist into hyperextension with one hand and stretch the thumb into full extension with the other hand (Fig. 12.23). Hold this stretch position for about 20–30 seconds to enhance elongation of the TCL and flexor tendons.

C. Median nerve mobilization In the later stages of rehabilitation CTS treatment is enhanced by increasing mobilization of the median nerve so it can freely move within the tunnel. Median nerve mobilization is performed by taking the nerve to a fully stretched position, slackening the nerve somewhat, and then returning it to a stretched position. The fully stretched position for the median nerve has the shoulder abducted, elbow extended, and wrist hyperextended (Fig. 12.24). Once the stretch position is reached, symptoms may recur. Do not hold the nerve in the stretched position like you would hold a muscle stretch. Immediately return the nerve to a slackened position. This stretching process is repeated multiple times to help encourage neural mobilization.

Figure 12.24 Neural stretching for median nerve.

Rehabilitation protocol considerations

- As with other nerve compression pathology, nerve damage is slow to heal. Immediate or rapid results can occur but resolution of the condition is more likely to be a slow and gradual process.
- The choice of treatment techniques and approaches for this common nerve compression

syndrome are highly variable. If the condition is severe and symptoms are magnified, treatment pressure, duration, and intensity must all be adjusted to the appropriate needs of the client so that aggressive work does not further exacerbate the condition.

- Techniques such as the neural mobilization procedure can aggravate nerve symptoms if performed aggressively. Use caution with these procedures and pay close attention to signs of symptom aggravation.

Cautions and contraindications Because this condition involves nerve compression, the main goal of treatment is to reduce or remove the compression on the nerve. Use caution with any technique that puts additional pressure on the carpal tunnel region. Methods such as the myofascial release technique described above may be appropriate in some cases (mild to moderate) and not appropriate in others. Appropriate clinical judgment about technique choice is essential. It is also important to evaluate the possibility of other regions of median nerve entrapment (the double or multiple crush) that can contribute to exacerbation of carpal tunnel symptoms.

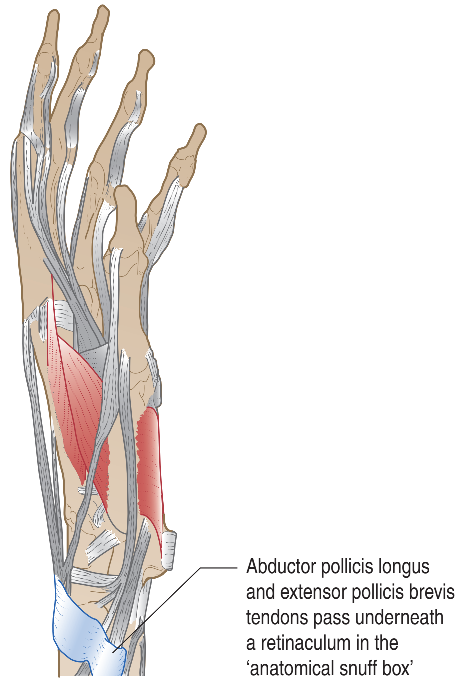

Figure 12.25 Side view of the left wrist showing tendons of the 'anatomical snuff box.'

DE QUERVAIN'S TENOSYNOVITIS

Description

Tenosynovitis can develop in tendons surrounded by a synovial sheath. The majority of the sheathed tendons are in the distal extremities. In tenosynovitis, repetitive overuse causes an irritation or inflammatory reaction between the tendon and its synovial sheath. The tendons of the abductor pollicis longus and extensor pollicis brevis muscles share a common synovial sheath near the styloid process of the radius. This region is known as the *anatomical snuff box* (Fig. 12.25).

The retinaculum that covers these tendons is an extension of the extensor retinaculum on the dorsal surface of the wrist. In other regions of the body, tendons course under a retinaculum without any tissue between the tendons. However, there is an anatomical variation in some individuals in which a septum or fascial wall exists between the abductor pollicis longus and extensor pollicis brevis tendons. This septum creates a smaller chamber for the extensor pollicis brevis and these individuals are more likely to develop de Quervain's tenosynovitis.[60] In a study of cadaver specimens, a septum was found in 77%, indicating that the septum is relatively common.[61]

A frequent cause of de Quervain's tenosynovitis is repetitive irritation of the tendons. The repeated friction leads to fibrous adhesion between the tendon and its synovial sheath, as well as some degree of local inflammation. This condition also develops from direct trauma, although the acute cause is not as frequent. Ordinarily, inflammation associated with de Quervain's tenosynovitis is not severe and may not be visible. Local tenderness is a more significant indicator of the underlying pathology. Tenderness is felt directly over the anatomical snuffbox when it is palpated. If the inflammation is severe, other nearby structures can be affected. The dorsal sensory branch of the radial nerve passes directly over this area. If local inflammation creates pressure on this nerve there may be paresthesia sensations in the thumb, dorsum of the hand, and index finger.[55]

Treatment

Traditional approaches

De Quervain's tenosynovitis is commonly treated with a variety of modalities, including heat, phonophoresis, and various active exercises to encourage free movement of the tendons within their sheath.[28] Cold applications may also be used to reduce local inflammatory response. If conservative treatment is not successful, corticosteroid injections are sometimes used to address the inflammation. Corticosteroids are also administered with phonophoresis or iontophoresis. There are some concerns about the effect of corticosteroids on connective tissues, so it advised that these approaches be used sparingly. If neither conservative treatment nor injection therapy yield beneficial results, surgery may be the next option. Surgical procedures focus on decompressing the tendons underneath the retinaculum. The primary problem is often the septum that exists between the abductor pollicis longus and the extensor pollicis brevis. Surgery involves cutting the septum to decompress the extensor pollicis brevis muscle.[62,63]

Soft-tissue manipulation

General guidelines Tenosynovitis develops from overuse and fatigue of the abductor pollicis longus and the extensor pollicis brevis muscles, whose tendons course underneath the retinaculum; treating the tension in these muscles is beneficial. Because they are relatively long and thin, it is most effective to treat these muscles with specific longitudinal stripping techniques. These muscles wrap around to the dorsal surface of the wrist and forearm, so the longitudinal stripping methods should focus on the distal aspect of the forearm on the dorsal surface.

Other muscles acting on the thumb can also be hypertonic from overuse, and should be treated. The extensor pollicis longus can be treated on the dorsal surface of the forearm as treatment is applied to the extensor pollicis brevis and abductor pollicis longus.

The flexor pollicis longus tendon and muscle belly are close to the anatomical snuff box, and when hypertonic can give sensations that can be confused with de Quervain's tenosynovitis. The flexor pollicis longus and eight flexor tendons lie underneath the flexor retinaculum. They can be treated with longitudinal stripping methods on the volar aspect of the distal forearm. Deep transverse friction (DTF) massage is commonly advocated for addressing tenosynovitis.[64] The pressure and transverse movement on the tendon mobilizes adhesions that have developed between the tendon and its sheath.

Prior to performing deep stripping on the thumb tendons, apply warming techniques to the area, such as effleurage or sweeping cross fiber movements. Compression broadening techniques applied to the wrist flexors and extensors is also helpful to prepare the tissues for more specific treatment.

Suggested techniques and methods

A. Deep stripping on thumb tendons Deep stripping can be used to encourage tissue lengthening after general relaxation techniques are performed on the area such as effleurage or compression broadening. Hold the client's hand or wrist in a neutral position with one hand while applying this technique with the thumb or fingers of the other hand. Apply a deep specific stripping to the tendons and muscle bellies of the abductor pollicis longus and extensor pollicis brevis (Fig. 12.26).

B. Pin and stretch on thumb tendons The primary purpose of this pin and stretch technique is to enhance mobility between the tendon and the surrounding sheath, as well as encourage

Figure 12.26 Deep stripping to abductor pollicis longus and extensor pollicis brevis.

lengthening and pliability of the affected muscles. Grasp the client's hand so that it is easy to move the hand in radial and ulnar deviation. Start with the hand in full radial deviation. While one hand holds the client's hand, apply static pressure to the abductor pollicis longus and extensor pollicis brevis muscles with the opposite thumb. While holding pressure on those muscles, pull the client's hand into ulnar deviation (Fig. 12.27). As a variation on this technique, deep stripping can be applied during the ulnar deviation instead of static compression. The deep stripping technique further enhances tissue pliability and reduction of adhesions between the tendon and synovial sheath.

C. Deep transverse friction on thumb tendons at the anatomical snuff box Adhesion between the tendons and the surrounding synovial sheath is most effectively addressed with deep transverse friction (DTF). Friction is effective in breaking up adhesions when it is performed transverse (perpendicular) to the tendon fiber direction. For best results, put the client's hand in ulnar deviation in order to keep the tendons on stretch (Fig. 12.28). Perform DTF to the affected tendons alternating the friction technique with various passive wrist movements, general effleurage, sweeping cross fiber, and other techniques to encourage greater pliability and tendon mobility. In addition to the friction treatments on these tendons, encourage the client to stretch the wrist in this position on a regular basis.

Figure 12.27 Pin and stretch for abductor pollicis longus and extensor pollicis brevis.

Figure 12.28 Deep transverse friction at Guyon's canal.

Rehabilitation protocol considerations

- Reducing muscle tension in the affected muscles is an important part of addressing tendon adhesion. Make sure all forearm muscles are adequately treated in addition to the attention focused on the dysfunctional tendons.
- Friction techniques, pin and stretch, and the other techniques applied directly to the affected tendons can be uncomfortable for the client. This treatment strategy is still helpful even if it is uncomfortable. However, pain should not be unbearable. Adjust the treatment to fit the client's comfort tolerance, but explain that treatment is more effective if they can withstand tolerable discomfort.
- Ice applications are beneficial both before and after the specific stripping and friction treatments to reduce pain associated with the treatment. However, keep in mind stretching and flexibility enhancement will not be as effective immediately after the cold applications due to decreased connective tissue pliability.

Cautions and contraindications Effective treatment of de Quervain's tenosynovitis often involves some level of discomfort for the client. Use caution when administering this treatment and pay close attention to the pain threshold of the client.

There are several branches of the radial nerve that are very close to the affected tendons in this region. Any sensations of paresthesia or shooting pain in the hand during treatment may indicate pressure on these nerves, and treatment should move to a different region.

Box 12.3 Clinical Tip

Few occupational injuries are as common for massage practitioners as tenosynovitis in the wrist and finger tendons. The unique hand positions used in massage and the muscular stress applied to the hands all day long put the massage practitioner's hands in a susceptible position. Tenosynovitis can be a stubborn condition that takes a long time to heal. Massage practitioners are strongly advised to take preventive measures to keep this occupational injury at bay. The techniques that are described for treating a client with this condition are easy to administer to yourself, and they are effective in prevention as well as treatment. Strength training and conditioning of the wrist, hand, and fingers is also a great way to reduce the likelihood of developing problems with overuse tenosynovitis from massage.

GUYON'S CANAL SYNDROME

Description

The ulnar nerve courses along the medial side of the forearm from the elbow to the wrist. When it reaches the wrist it enters a canal or tunnel, just like the median nerve in the carpal tunnel. This tunnel is called Guyon's canal (also called the tunnel of Guyon). The canal is the narrow space created by a division of the TCL, through which the ulnar nerve and the ulnar artery must travel (Fig. 12.28).

The space in Guyon's canal is quite narrow. However, unlike the carpal tunnel there are no tendons that pass through Guyon's canal. Consequently, tenosynovitis causing nerve compression is not an issue for the ulnar nerve as it is for the median nerve in the carpal tunnel. Ulnar nerve compression in Guyon's canal generally results from forces outside the body pressing on the nerve as opposed to compression developing within the tunnel itself. In acute cases, the compression occurs from striking the hand. For example, banging an object or surface with the base of the palm can lead to ulnar nerve compression.

Chronic compression of the ulnar nerve at Guyon's canal is more common than acute injury. It develops in activities such as long distance cycling because of the cyclist's hand position on the handlebars and the pressure placed directly on Guyon's canal. When it occurs in cyclists, the condition is called handlebar palsy. A similar situation develops where pressure on the handle of a cane used to assist in walking creates chronic nerve compression. Guyon's canal syndrome also commonly results from occupational disorders. For example, it occurs in construction workers who hold tools in a position so that chronic pressure is placed on the nerve.

Symptoms of ulnar nerve compression in the Guyon's canal include sensory impairment or paresthesia sensations that are felt in the cutaneous distribution of the ulnar nerve which includes half of the ring finger and pinky. Pressure applied directly over Guyon's canal aggravates the sensory symptoms. Motor symptoms of weakness and/or atrophy are common for ulnar neuropathy at the wrist because the ulnar nerve supplies a number of muscles in the hand.

The ulnar nerve also supplies motor fibers to the adductor pollicis muscle of the thumb. The adductor pollicis muscle plays an important role in opposition movements of the thumb. Opposition is the combined movement of the thumb where the pad of the thumb is brought into contact with the pads of one or more of the other fingers. If there is impaired nerve function to the adductor pollicis muscle, the individual has difficulty maintaining a strong pinch grip between the thumb and fingers.

Several other factors can lead to Guyon's canal syndrome. Fractures of the carpal bones either at the time of an acute injury or sometime later during the healing process can produce nerve compression. Small fibrous tumors, cysts, or blood clots in Guyon's canal have also been identified as a cause of the condition.[65] Symptoms of ulnar nerve compression can occur along with symptoms of CTS.

Treatment

Traditional approaches

Conservative approaches are the usual treatment for Guyon's canal syndrome. Nerve compression usually results from compression on the palm so rest from aggravating activity is the first step. Reduction of offending activities is essential to allow for adequate nerve fiber healing time. Wrist splints are helpful as they can reduce additional irritation from neural tension developed during wrist extension. These are particularly useful at night to keep the hand in a neutral position to relieve pressure and encourage nerve healing. As long as compression is not severe, the nerve damage usually repairs on its own, although the rate of healing is slow. The healing rate is dependent on how long the nerve compression has existed and how severe it is. The longer the compression pathology has been present, the slower it is to heal. A nerve conduction velocity test is sometimes performed in order to identify the compression site. Surgical decompression of the nerve is sometimes performed, but not often. Since pathologies of ulnar neuropathy at the wrist likely involve external factors of compression, removal of that compression is usually sufficient to treat the problem.

Soft-tissue manipulation

Because there are no tendons traveling through Guyon's canal as there are in the carpal tunnel, there is not a significant musculotendinous contribution to this problem. External compression of the nerve has caused the condition. For this reason, massage techniques should not put additional pressure in the Guyon's canal region. Massage may give some symptomatic relief in the region and elsewhere through the upper extremity if adverse neural tension has contributed to the nerve irritation.

Pressure on the ulnar nerve in Guyon's canal can be aggravated by adverse tension or compression on the ulnar nerve in other regions of the upper extremity. Therefore, massage treatment should focus on enhancing mobility of the nerve throughout its entire length from the brachial plexus into the hand. Particular areas to emphasize neural mobility include the thoracic outlet region and near the cubital tunnel of the elbow. While these are the most common locations of ulnar nerve entrapment, they are certainly not the only places where nerve entrapment can occur. Consult the treatment recommendations for these other conditions (thoracic outlet syndrome and cubital tunnel syndrome) to formulate a comprehensive plan for addressing these potential ulnar nerve restrictions in the upper extremity.

Suggested techniques and methods

A. Compression broadening to wrist flexors After superficial warming techniques such as effleurage and sweeping cross fiber, attention can focus on enhancing neural mobility by treating the forearm flexors. The wrist flexor muscles are worked with compression broadening techniques. The client is supine with the forearm supported by the table. Perform the strokes on the wrist flexor muscle group using the thenar eminence of the hand (Fig. 12.11). Each compression broadening stroke is a cross fiber movement so it does not matter if the strokes move progressively toward the elbow or toward the wrist.

B. Deep stripping to wrist flexor group Tissue elasticity is enhanced and muscle tension is reduced with deep stripping techniques. This technique can aid mobility of the ulnar nerve. Use the fingers or thumb to perform a deep longitudinal stripping technique on the wrist flexors that begins at the wrist and continues to the flexor attachment site at the medial epicondyle (Fig. 12.12). This stroke uses deep specific pressure on the extremities, so follow the direction of venous return and move distal to proximal with each stripping motion. Continue the technique in successive strips until the entire muscle group has been treated.

C. Myofascial release of transverse carpal ligament This technique is aimed at reducing tension in the TCL, especially in the treatment of CTS. It can also be helpful for Guyon's canal syndrome because the ulnar nerve is underneath a portion of the TCL. The client is supine with the forearm supinated so the palm is facing up. Grasp the client's hand and apply pressure in opposite directions across the base of the client's hand with the thumbs to the attachments of the TCL (Fig. 12.22). Hold this stretch position for about 20–30 seconds to enhance elongation of the TCL and flexor tendons. This technique should not increase neurological symptoms so do not continue pressure for a prolonged period if it does. However, a short duration of symptom increase during pressure on this region should not cause adverse effects.

D. Ulnar nerve mobilization Symptoms of Guyon's canal syndrome can be aggravated if there is adverse neural tension on the ulnar nerve. This technique enhances mobility throughout the length of the ulnar nerve. Begin with the client's arm at the side with the elbow extended and the wrist in a neutral position. Moving the upper extremity at a moderate pace to stretch and mobilize the ulnar nerve, bring the extremity into a position of elbow flexion, full wrist extension and shoulder abduction (Fig. 12.17). Bring the client's arm only to the point where symptoms are first felt. Once that point is reached, bring the arm back into a slackened position for the nerve (toward the original starting position). Repeat this process of neural stretch and relaxation a number of times to encourage mobility of the ulnar nerve along its length. Emphasize the wrist extension and elbow flexion to encourage greater emphasis of mobility in the distal portion of the nerve (near Guyon's tunnel). If neural symptoms increase with the movements, do not continue the process.

Rehabilitation protocol considerations

- If the nerve compression has occurred from a direct blow to the nerve, such as hitting the hand or palm on a hard object, the canal region is likely to be tender and easily reproduce symptoms. Choose treatment techniques that do not put any additional stress on this region.
- Guyon's canal compression syndromes frequently resolve without intervention, albeit slowly, as long as the cause of external compression has been reduced or eliminated.
- Ergonomic suggestions to help reduce external nerve compression are important for those developing the condition as a result of work activities.

Cautions and contraindications Be careful about applying pressure to the anterior wrist region if the client appears to have Guyon's canal syndrome. Further compression of the nerve will not provide therapeutic benefit and will cause the condition to worsen. If irritation of the nerve is caused by a space-occupying lesion, such as a tumor or cysts, massage could be detrimental. For severe cases or when an offending activity cannot be determined, referral to another health care practitioner to rule out these causes is advised.

Box 12.4 Case Study

Background

Mia is a 37-year-old production assistant at a local news agency. She routinely works long hours and her job requires an extensive amount of work at the computer. Over the last month she has had an increased workload due to a complex story that her news organization was working on. To complete the story she had to spend several weeks traveling and doing a great deal of her work on a laptop computer, which she does not ordinarily use at the office. The laptop keyboard is much smaller than the one she is accustomed to and she had to set it on a table in her hotel room to work. She noticed that the work position felt uncomfortable and she was noticing increasing discomfort in her forearm and hand.

She describes an aching sensation on the medial side of her forearm that extends down into her hand. The pain does not appear to be localized to a single site, but is more of a generalized aching throughout the forearm. She notices that this pain is now bothering her with increasing frequency, even though she has returned to working mostly in her office once again. She has not seen a physician or other health care provider for this problem. She has had massage therapy in the past and is aware of how much it has helped her relax, so she is curious to consider if it might be helpful for this forearm and hand pain condition.

Questions to consider

- Mia's forearm pain seems to have resulted from a change in activity levels with the extensive work she was doing on a computer she was not accustomed to working on. How could this change in work environment lead to the development of her forearm pain?
- If massage treatment is deemed appropriate for her, are there other regions besides her forearm that would benefit from soft-tissue therapy?
- What kinds of things should Mia consider doing at home to help her soft-tissue treatment and prevent this kind of problem from recurring?
- If Mia has developed an overuse tendinosis in her wrist flexor muscles, would it be a good idea for her to begin a strength training and conditioning program now?
- How might muscle tightness in her upper back or neck be related to the onset of her forearm pain?
- If her forearm and hand pain appear to be caused by muscle overuse and minor nerve compression in her forearm, is massage a beneficial strategy to help her with this problem?

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